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PRINCIPLES OF TAXATION.

By DAVID A. WELLS, LL.D., D.C.L.,
CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC.

V.—LIMITATION AS RESPECTS INSTRUMENTALITIES BY WHICH TAXATION IN A CIVILIZED STATE EFFECTS ITS PURPOSE.

ATTENTION is next asked to the instrumentality by which taxation subserves the necessities of the state and enables it to effect the purposes for which it was instituted. The designation of this instrumentality is "revenue," as is indicated in the phrase "tariff (or taxation) for revenue." But the term "revenue" is abstract and most indefinite, and as popularly used conveys little meaning other than a receipt of something of value. In rude or incipient forms of government, where tribute or taxes were payable in cattle, skins, cocoanuts, salt, grain, and the like, the term might be fairly interpreted as an income of property in general. But in a *highly civilized* state such a meaning is inadmissible. The government of such a state obviously could not defray its varied expenses by payments with various articles of property, even though their value may be unquestioned—as, for example, its executive with fish, fresh or salt; its legislators with distilled or fermented liquors; its judges with boots and shoes; its soldiers and sailors with cotton or corn; and its clerks with agricultural implements—even though the producers of all these forms of wealth or property may be most willing to give them in discharge of their tax obligations.* In such a state revenue has

* In ancient times cattle were regarded among nations of a considerable degree of civilization as standards of value, and obligations to government in the nature of taxes were payable therein. As recent, moreover, as 1758 taxes in Virginia and Maryland were pay-

and can have, therefore, but one meaning—namely, *money;* because money is the indispensable and practically the only means of defraying the expenses of the state and efficiently administering its government; and taxation is the process by which the state obtains money from its citizens, who in turn obtain (as before pointed out—see Chapter III) it in exchange for some product of their labor or for some direct personal service. In short, money is an expedient that finds its sole justification in its adaptation to a special purpose.

At the same time it is important to bear in mind that the raising or procurement of money with the view or purpose of accumulating wealth is not a legitimate function or object of civil government.

This point, which, stated and regarded as an abstract proposition, may seem to the reader as a matter of interest but of little practical importance, finds a very interesting and most instructive exemplification in the recent attempt to govern South Africa by means of a chartered company—"The South African Company." The attempt failed by the confusing on the part of the company of two things which are absolutely irreconcilable and ought never to be associated—namely, the prerogative of governing men on the one hand and the desire of making money on the other. This the company in question attempted to do by taxing the inhabitants of the territory embraced in its charter for the purpose of making dividends for shareholders, who as a rule did not live in the country, but mainly in England. The result has been a thoroughly vicious and intolerable form of government, one which "has operated to deaden the sense of responsibility among the rulers, who are here to-day but are gone to-morrow, and answerable to nobody but the company."

Now, if these premises are correct—and it is difficult to see how they can be disproved—it would seem to follow that to seek to make taxation, which is a fit contrivance only for raising revenue, an instrument for effecting some ulterior purpose, be it never so just and legitimate, to seek to use it for the attainment of any other advantage than the obvious one of raising money, is to lose sight of a fundamental principle of every free government and to forbid all expectation of recognizing any other basis for the exercise of this great sovereign power of the state than expediency, which in turn will depend upon the actions, passions, and

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able in tobacco; and in Massachusetts, Indian corn, musket balls, dried peas, cattle, and beaver skins were made legal tender for the payment of taxes until the early years of the eighteenth century. Ultimately, and in all cases as civilization advanced, such media for the payment of taxes, or the discharge of other forms of indebtedness, have been found to result in terrible currency confusion and to be wholly impracticable.

prejudices of legislators, who may not be the same in any two successive legislative assemblies.

Such a perversion of principle, furthermore, reaches its climax of absurdity in practice when its immediate beneficiaries claim to be the only proper persons by whom the incidence and amount of taxation can be intelligently determined—a claim that is practically equivalent to the assumption that privilege should take precedence of rights in the theory of government.* And yet there have been but very few of the revenue enactments in recent years of the Federal Government of the United States that have not only indorsed the rightfulness and desirability of such claims, but have made them the basis of most important legislation.

As this subject has hitherto received but little attention from legislators and the legal profession in the United States, the following citations from recognized American authorities are most pertinent in this connection:

"A burden laid not for the purpose of producing revenue, but in order to accomplish some ulterior object which the General Government lacks the power otherwise to accomplish, comes under no definition of the word "tax" which is recognized in public law. It demands no contributions for the service of the state; it adds and is expected to add nothing to the public revenue. It annihilates that upon which it is levied, and it differs from confiscation only in this: that confiscation seizes something of value and appropriates it to the needs of the Government, thus making it useful, while this seizes it for the purpose of destruction."—*Cooley, Law of Taxation, p. 75.*

"One grievous invasion of property—and of course ultimately of labor, from whose accumulations all property grows—is by Government itself, in the shape of taxation for objects not necessary for the common defense and general welfare. Men have a right not only to be well governed, but to be cheaply governed—as cheaply as is consistent with the due maintenance of that security for which society was formed and government instituted. This, the sole legitimate end and object of law, is never to be lost sight of—security to men in the free enjoyment and development

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* In popular discussions of tariff revisions in the United States such a claim has actually been advanced by the representatives of interests in whose behalf certain imposts had been specially enacted, and which were not for purposes of collecting but rather for the prevention of revenue.

"It is not claimed that this statute [McKinley Tariff Act], any more than any other human ordinance, was perfect in its details, nor that all its rates of assessment of duties should have been maintained, but the modifications suggested by time and experience should have been left to the friends of the measure."—*Letter of the Hon. L. P. Morton, accepting nomination for the office of Governor of New York, October 9, 1894.*

of their capacities for happiness—security: nothing less, but nothing more."—*Sharswood, Legal Ethics.*

"To the extent that the mass of our citizens are inordinately burdened beyond any useful public purpose and for the benefit of a favored few, the Government, under pretext of an exercise of its taxing power, enters gratuitously into partnership with these favorites, to their advantage and to the misery of a vast majority of our people."—*Message of Grover Cleveland, President of the United States, December, 1888.*

TAXATION FOR REVENUE ONLY. WHAT DOES IT MEAN?—It is essential to the completeness of this discussion to call attention at this point to the circumstance that a full recognition and rigid adherence in practice by a Government to the principles of taxation above shown to be fundamental, will not interfere with or impair the efficiency of its administration. The raising of revenue (money) by taxation is one thing; the determination of how the revenue collected shall be used or expended is quite another thing; and the danger line to the liberties of the people is crossed when these two functions are confounded. The exercise of the first, as already pointed out, is subject to limitations growing out of the conditions essential to the existence of a free Government. The determination of the second rests primarily in the legislative department of such Government, and is subject to no legal limitations in the United States other than what flows from the oft-repeated *dicta* and decisions of its highest judicial authorities, that money taken out of the pockets of the people by taxation can not be used (expended) for any other than a public purpose; but what constitutes a public purpose is so indefinite that one eminent jurist, especially versed in the subject, has declared that "there is no such thing as drawing a clear line of distinction between purposes of a public and those of a private nature."*

If a state, therefore, in the plenitude of the wisdom of its legislators, desires to interfere with the operation of the laws of trade, domestic or foreign, control the preferences of its citizens in respect to production or consumption, repress one form of industry and stimulate another, and discourage even to prohibition the indulgence of such tastes and passions as it may judge to be detrimental to itself or the individual, it may legitimately exercise functions entirely different from that exercised in raising revenue and governed by entirely different principles. The right to regulate trade and commerce and the power of police are entirely independent of the right to raise revenue.

If the state, in providing itself with what it regards as necessary revenue, levies its taxes in such a manner that no citizen is

* Cooley, Law of Taxation, p. 70.

required to pay more or allowed to pay less than his just proportion, then there is no tyranny in taxation, even if the methods employed, without any such intent, may incidentally promote private interests and sumptuary purposes. But if, on the other hand, a just and equitable method of taxation will not promote these purposes, and, as usually the case, the state resorts to methods that are not just, not equitable, and imposes upon some citizens an undue share of the general public burden, then to that extent taxation becomes tyrannical, and can not be justified except upon the assumption that there is no limitation on the right of a state to interfere with individual rights to property; which is the same thing as asserting that the state in question is not "free," but is a "despotism." In short, the proposition would seem to be clear that the state can not, without violating that simple principle of justice which prescribes equality in taxation, use its taxing power for effecting any other purpose whatever except to raise money.*

The principle here involved may be further illustrated by reference to a curious chapter of railroad experience. Some years ago the managers of one of the great railroads of the United States appropriated a part of its receipts from the carriage of freight and passengers to the support of an opera house and a corps of ballet dancers. Extraordinary as was this procedure, there was no question that the directors, who were trustees for the stockholders, had the right to determine how the earnings of the road should be applied, so long as the stockholders failed to restrain them or prevent their continuance in office; and as they did not, no legal action or restraint of their singular use of the receipts of the property was attempted. But if these same directors had decided not to take money directly from the aggregate earnings of the railroad for the furtherance of their peculiar views, but that in addition to certain rates for transportation all passengers and freight should pay a special sum (tax) for the support of the opera house, the state would have undoubtedly and properly intervened and forbidden its collection, on the ground that the railroad was not chartered (called into existence) for any such purpose, and that the attempt to use any power other than what was granted or contemplated in its charter was illegal and unwarranted.

Again, if the legislative department of the state decides that

* A legal writer of eminence (Justice Cooley) has recently contended that this is not a correct view, for the reason that it is one which finds no "countenance in the practice of our Government, or indeed that of any other." But if this contention is valid, then it may be pleaded with equal effect for the justification and continuance of every practice which old-time views and long usage have tolerated, but which a higher civilization or a broader culture demands shall be abrogated.

it would be expedient to establish or stimulate the manufacture of certain commodities, no one under a free government would venture openly to justify such action, except on the ground that public welfare would be thereby promoted, although practically such justification in the United States has long since ceased to be other than a pretense and a cover for the promotion of private interests. Suppose, for example, that the manufacture of the commodity which it is proposed to stimulate is tin plate, and it is decided that the desired result can be best attained by giving the domestic manufacturer the difference between what his product will sell for in a free market and what he can make it for—say fifteen million dollars per annum—it would seem to be only simple justice that the state should fairly and honestly pay the sum representing this difference, and raise the money,* not by a tax on the consumers of the product artificially maintained, who are no more interested in the matter than all other citizens, but by a levy upon the community at large, in the same equitable manner as it raises money to defray its other expenses. In short, if any industry can not live without state aid, and it is for the public welfare that it should live, let the state directly subsidize it, and not maintain it by allowing private interest arbitrarily to exercise the great sovereign power of taxation.†

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* A written public statement made by a Senator of the United States (George F. Hoar), in 1892, that an assertion by the National Democratic party of the United States in its presidential platform of that year that "the Federal Government has no constitutional power to enforce and collect tariff duties except for the purpose of revenue only," was equivalent to an unveiling of an opinion that "the American people alone, of all civilized nations, have no power to do anything for the encouragement of their own industries," displayed an amount of ignorance and misconception of the powers and objects of the Government he served which, to say the least, was discreditable to its author.

† "Granting that it is expedient for the Government to spend money in the maintenance or the promotion of the iron manufacture, for example, it must be expedient also that the public should know the exact amount which it costs annually, just as it is expedient that the public should know exactly how much the army and navy costs, or how much the annual improvement of rivers and harbors costs. No view, however broad, of the province of government can furnish an excuse for concealing the expense of any great national undertaking. . . . But there is no trace of this expenditure in the national accounts. . . . Next, it must be said that any fund of large amount, raised and distributed in this way, must of necessity prove a corruption fund. By this I do not mean a fund distributed in bribes to individuals or organizations, but a fund the existence of which must be constantly present to the mind of the lazy, the improvident, or incompetent, as something to fall back on if the worst come to the worst. Suppose the national appropriations for the purpose of protecting manufacturing industry were made in the ordinary way by a distinct vote of Congress; were made, for instance, as the appropriations for the promotion of the carrying trade—the steamship subsidies, as they are called—are made in the shape of an annual maximum sum. Suppose this sum were paid over to the corporations or individuals engaged in each manufacture on their giving proof that they were carrying on a *bona-fide* business. Suppose that to each were given as much as would meet the loss, as shown by his books, incurred by him in competing with foreigners in the home markets. . . . The

This was the idea of Alexander Hamilton, who in the early days of the republic favored state interference with the pursuits of the people to a large extent, as the best method by which domestic manufacturing should be stimulated by the state. This idea, however, found no more favor with the parties specially interested at that time than it would at present; inasmuch as a brief practical experience would so soon demonstrate the smallness of the revenue necessary to be raised by honest taxation for the direct maintenance of an industry by the state, in comparison with the amount raised, for the most part by inequitable and unjust taxation for the support of that form of interference by the state with production which goes under the name of "protection," as to make any long toleration of the latter policy by a free people exceedingly unlikely.

GENERIC DIFFERENCE BETWEEN THE "TAXING" AND "POLICE" POWERS OF THE STATE.—Attention is next asked to the generic difference between the "taxing" and "police" powers of the state (to which a brief reference has been made already), and to the incongruities and governmental abuses that inevitably result from a lack of full recognition of this fact. The object of the taxing power is to raise money to defray the expenditures of the state, and proof and argument seem conclusive that it can not be legitimately used for anything else. By the power of police is understood the internal regulation of the affairs of the state in the interest of good order. The idea, therefore, of resorting to taxation for the purpose of protecting individuals against their own foolishness, enforcing morality, preventing social evils, or as an instrumentality for the punishment of crime, is to pervert an agency from the one sole purpose for which it can rightfully exist to another less fit and not warranted by necessity, and presupposes an entire misconception of the principles of a free government; and all perversions of this power are certain to entail evils greater than the abuses which it is devised to remedy. If the prosecution of any trade or occupation, or the manufacture and use of any product constitutes an evil of sufficient magnitude to call for adverse legislation, let the state proceed against it directly, courageously, and with determination. To impose taxes upon an evil in any degree short of its prohibition is in effect to recognize and license this evil. To demand a portion of the gains of a person practicing fraud, may be an effectual method for putting an end to his knavery by making his practices unprofitable; but it would be, all the same, a very poor way for a state to adopt as a means

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political objections to the protective system can not be made so clear as by inquiring how the plan of distributing the money directly by the public Treasury would work."—E. L. GODKIN, *Problems of Modern Democracy.*

for suppressing fraud. If absolute prohibition is the object, then such result should be attained through the police force of the state, and through its legislative enactments making the act, powers, or products which it is desired to suppress, misdemeanors or felonies. The manufacture and sale of spirituous liquors, in common with all other branches of business, is a legitimate subject for taxation, but there is a broad distinction—indeed, nothing in common—between taxing this business for revenue and in levying taxes with a view of preventing the business from being transacted at all, and so preventing revenue.

Again, if the above analysis of the origin, justification, and limitations of the power of taxation is correct, it would seem evident that to seek to make the occasion for the exercise of the power other than necessity, and the object anything else than the raising of money for meeting the expenditures of a government economically administered, is to strike a blow at not only good government, but also at free government. It is also a flat denial of the authoritative statement of the United States Supreme Court that "there are rights in every free government beyond the control of the state," and that the theory of our Government, State and national, admits of no place for the deposit of unlimited power. For the deliberate recognition and indorsement of the right on the part of the state to disregard these limitations in a single instance, is equivalent to a denial that there are any such, and certainly in this one department makes the Government despotic rather than free. Once recognize the principle of inequitable taxation, and no one can foresee how far it may be carried.

If it is contended, as it is, that the use of the power of taxation for purposes other than the collection of revenue finds justification in the fact that "the law-maker must look far enough beyond the general purpose to satisfy himself how any proposed levy is likely to affect the general good," a sufficient answer to such contention would seem to be that the general good is always best subserved by doing what is exactly right, and not what is expedient.

There is no question that the Federal Government of the United States, under its peculiar organization, is excluded from all responsibility for the internal order or morality of the States that make up the Union, and under such circumstances it follows that where Congress assumes that the consumption or use of certain commodities is prejudicial to the interests of the people (as it has done, as will hereafter be shown), and attempts, when providing means for the support of the Federal administration, to embody such assumptions, with a view of prohibitions or restraints, in measures of revenue, it is also enacting sumptuary

laws* and imposing taxes, not in accordance with any rule of equity, but by reason of some arbitrary and sentimental notions of how a citizen ought to live, dress, eat, and drink. In the case of the several States of the Union, whose power of taxation is practically unlimited, such action is in the nature of oppression; but in the case of the Federal Government, whose powers of taxation are carefully limited by its Constitution, it is clearly an act of usurpation. In further elucidation of this matter, it is interesting to note, that probably no example can be found in history in which an attempt has been made to continue the raising of revenue with the regulation of popular consumption, that has not resulted in failure as respects the attainment of both objects.

One of the most notable perversions of the correct principles of taxation for the purpose of affecting the popular consumption of a commodity, has been the comparatively recent attempt of the Federal Congress (act of August, 1886) to prevent the use of one of the great discoveries of the age—namely, the manufacture of artificial butter, which, when properly prepared, is a most valuable and perfectly healthful addition to the food resources of the people. The practical results of this attempt are exceedingly curious and ought to be in the highest degree instructive. The burden of the tax—two cents per pound and special taxes on manufacturers, wholesale and retail dealers—which was intended to be prohibitory, has not been sufficient to accomplish the object of its levy; for the annual production, sale, and consumption of oleomargarine in the United States have continually increased (from 34,325,000 pounds in 1888, to 48,364,000 in 1892, and 69,622,000 in 1894). The Federal courts having decided that it is merchantable, the States may to a certain extent also regulate its sale, but can not prevent its importation. The Federal Government furthermore derives a considerable revenue from its domestic manufacture and sale ($1,409,211 in 1895); and also exports an annual large and increasing quantity for the consumption and use of foreign countries (127,193,000 pounds in 1894); and clearly, if such production and sale are fraudulent and wrong, the Government has become a partner in such fraud and wrong and in effect licenses them.

It is also an interesting fact that this idea of resorting to taxation for the primary purpose of enforcing morality and preventing social wrong is a comparatively modern idea, and finds its chief exemplification in the United States.

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* "Sumptuary: Relating to expense. Laws or regulations which restrain or limit the expenses of citizens in apparel, food, furniture, etc. Sumptuary laws are abridgments of liberty and of very difficult execution. They can be justified only on the ground of extreme necessity."—*Webster's Dictionary.*

The lesson of all history is to the effect that, save in the case of war or invasion, nations have rarely or never lost a freedom once possessed, except through the tolerance (born of indifference) of a succession of gradual and insidious perversions and weakening of those fundamental principles which must be maintained unimpaired to make popular liberty possible. And it is alike startling and discouraging to note how rapidly, in recent years, the United States, as a political entity, has been traveling in this direction.

THEORY OF THE POWER OF TAXATION ORIGINALLY ENTERTAINED BY THE AMERICAN PEOPLE.—The idea of using the power of taxation for other purposes than that of obtaining revenue for defraying the necessary expenditure of the Government, was one hostile at the outset to all the beliefs and habits of thought of the American people; was totally incongruous with the social and political system which they instituted and expected, and was reluctantly admitted under the idea that the industries of a new country might need some temporary stimulus and assistance at the outset.* The party (old Whig) that in subsequent years specially advocated the policy protection to domestic industries, always also admitted that the Federal Government had no original right to exercise the power of taxation except for revenue, but it claimed that taxes on imports might and should be so adjusted as to afford protection for our infant industries. And in this they were joined by some members of the other great national party—the Democratic—who argued in favor of what was called "incidental" protection, or the protection which inevitably results in a greater or less degree from the imposition of duties without any such premeditated purpose.

THEORY AND PRACTICE OF LATER DAYS.—But it was not until after the termination of the war in 1865 that anybody in the United States ventured to openly maintain or defend the proposition that protection was other than the incidental, and not the main object of the exercise of the taxing power, although this perversion of principle was tacitly recognized by the imposition and continuance of taxes which had for their intent, or resulted in a prevention of the raising of revenue.

ILLUSTRATIVE EXAMPLES OF THE PRACTICAL PERVERSION OF THE THEORY AND PRINCIPLES OF TAXATION.—One of the most instructive examples of this kind was afforded by the imposition of a tax in 1869 of five cents a pound on the importation of crude or unmanufactured copper; which proved so prohibitive that in

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* The doctrine of Hamilton was that while the payment of bounties for the encouragement of new industrial undertakings was justifiable, their "continuance on manufactures long established was most questionable."—*Report on Manufactures, 1791.*

one year (1878) revenue to the extent of only five cents, accruing from the importation of only one pound of copper, was collected. The legislators who enacted the law productive of such a result might have pleaded in justification that revenue was their intent;* but when a brief experience had proved that the taxing power had been used to prevent the raising of revenue by the state, and for a different purpose, it was evident that a continuance of the policy (and the tax was long retained) was in effect a justification and an indorsement of it. To complete the illustration, it should be further pointed out that the result of this perversion of the taxing power was to enable the owners of copper mines in the United States, especially certain ones of unprecedented richness—formerly the property of the United States, but sold for a mere song—to extort for a period of years from the people of the whole country the sum of five cents for every pound of copper they consumed, but from which exaction (aggregating millions) the people of other countries, who consumed the large surplus product of American copper exported, were exempt, as the tax laws of all countries have no extra-territorial jurisdiction. During the discussion and defense of this tariff enacted in 1890, however, all pretense and evasion were discarded, and the position openly taken that the Government could rightfully levy taxes, not for the purpose of raising revenue, and not to subserve any necessity of the state, and under the name of protection delegate to private or corporate interests the right to collect and appropriate them.

It has been contended by authorities worthy of all respect (the late George Ticknor Curtis, for example) that there is no perversion of the taxing power in the levy of duties on imports by the Federal Government for purposes other than revenue, for the reason that "duties are not taxes, but assessments, in the nature of tribute imposed on merchandise imported from other countries," and that "when the Government levies duties on foreign products," under the provision of the Constitution that "Congress shall have power to lay and collect taxes, duties, imposts, and excises," "it does not exercise or pretend to exercise its taxing power."

In answer to this it is to be said, first, that the application of different names to one and the same act does not alter the nature of the act; second, that usage and authorities among all nations and at all times are in unison in regarding such terms as imposts, duties, excises, customs, tolls, gabbele, talliage, tribute, and the like, when

* The United States Supreme Court has held that the judicial power can not inquire into the intentions of Congress in imposing a tax; and that, if injustice is done, the only remedy is an appeal to the legislative power that has inflicted it.

used in respect to the fiscal functions of a government, as expressive simply of different methods of effecting one and the same object—namely, the compelling of contributions from persons, property, or business for the use or support of the state. The contention, then, thus far is simply a quibble as to the meaning of words. Third, the authority given to Congress by the Constitution "to lay and collect 'imposts,' in connection with taxes, duties, and excises," does not warrant the assumption that any of these acts of levying and collection are to be by methods that are not primarily for the purpose of raising revenue (money) for the service of the state, or are antagonistic to the structure of a free government. Following the precedents before noted, a measure known as the Anti-option Bill has been introduced and found favor in Congress, which is nothing more nor less than an attempt to make people dealing in certain staple agricultural commodities honest by the exercise of the taxing power; a measure devised for effecting indirectly that which it would be unconstitutional to do directly—namely, to prevent trading in cotton, grain, hops, meats, etc., for future delivery, by first assuming that all such sales are "immoral, unnatural, unjust, and injurious," and then attempting to put an end to them, not by the exercise of the police power of the several States, but by licensing and taxing them by the Federal Government under pretense of collecting revenue, when by the very terms of the bill no taxes productive of revenue are likely to accrue from its provisions. It is difficult to see why, if this extraordinary measure is made law and obligatory on all citizens, the policy of restraint involved should not be made also applicable to the buying and selling of all articles other than cotton and cereals—as cloth, stoves, boots and shoes, securities—and even personal service; and why, if it is right to extinguish one trade or calling *by taxing it*, every other may not be uprooted and extinguished in the same way.*

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* As pertinent and most instructive on this subject attention is asked to the following extract from a speech of Hon. Edward D. White (then a Senator of the United States from Louisiana, and now a judge of the United States Supreme Court), in the course of a debate in the Senate in July, 1892, on the so-called Anti-option Bill: "No power as to imposts was reserved in the States by the Federal Constitution. All the lawful powers of government which could be exercised in that particular passed into the life and being of the Federal Government by the lodgment in that Government of the power to levy imposts. In my judgment, if complaint is made of impost taxes by the Federal Government, levied not for the purpose of revenue, but for protection or prohibition, the complaint is not that the Federal Government violates the Constitution or the limitations of the Constitution, because as to that all authority is granted by the Constitution. When I say this I mean no limitation by the Constitution by express provision of the Constitution. The complaint of undue or prohibitory external imposts is not that the Constitution has been violated.

"No, but that there has been a violation of the great fundamental and elementary principle of all government, which underlies all constitutions, which affect this Government and

Another proposition which has received the indorsement of high judicial authority in the United States * is to employ Federal taxation for the crushing out of State lotteries, with the absurd accompaniment of no revenue (taxes); for if the desired object is attained, the payment of taxes and the procurement of revenue will be prevented. It seems clear, also, that if such a measure was once adopted it would constitute a precedent and authority for the destruction by the Federal Government, through the exercise of the taxing power, of nearly every faculty or power now belonging to and exercised by the several States; and that houses of prostitution, gambling and liquor saloons, opium "joints," and other haunts of vice now under the control and supervision of the police powers of the States might be regulated or suppressed by Federal taxation, as well as lotteries.†

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every other government, and which would affect the most unlimited government in the world. These principles are that government is created with limitations flowing from the nature of its being, which teach that no government shall use its power for the benefit of the few to the detriment of the many. Therefore, all the arguments which have been made on the subject of the abuse of the impost power in the Federal Government are arguments addressing themselves not to the limit of delegation under the Constitution as to imposts, but to the want of power arising from the very nature of government itself. The usurpation of power by Congress, not vested by the Constitution in Congress, is unconstitutional."

The point here at issue was also clearly recognized by President Cleveland, in his message in 1886, announcing his signature to a bill (above noticed) for taxing oleomargarine, where the real intent of taxation was popularly assumed to be prohibitive of production and sale and not revenue. "It has been urged," he said, "as an objection to this measure that while purporting to be legislation for revenue, its real purpose is to destroy, by the use of the taxing power, one industry of our people for the protection and benefit of another. If entitled to indulge in such a suspicion as a basis of official action in this case, and if entirely satisfied that the consequences indicated would ensue, I should doubtless feel constrained to interpose executive dissent." In other words, the President took the bill as it came to him as ostensibly a revenue measure, and in the exercise of his executive prerogative passed upon it as such, but at the same time he was careful to say in this message that if that bill had not presented that aspect to him, he would have been constrained to exercise the executive veto.

In the course of the debate to which reference has been made, Mr. White, in response to a question as to what he would as a Senator consider his duty in respect to a bill proposed to Congress for enactment which, while undoubtedly productive of revenue, was intended for some other purpose, made answer as follows: "I would have two questions to ask myself: Is this a bill raising revenue? That is the first question. If I determine that question in the affirmative, the lamp of my duty might lead my mind toward supporting that bill, but it could not carry me to that point unless another question were also answered: Is it an honest exercise of the taxing power, or is it a dishonest scheme to raise revenue and accomplish another purpose? If my mind, in the exercise of my duty here, found that either of these things existed, then, although it was a bill raising revenue, I would not vote for a dishonest bill raising revenue."

* Judge Cooley, Atlantic Monthly, April, 1892.

† "Congress is not empowered to tax for those purposes which are in the exclusive province of the States."—*United States Supreme Court, Gibbons vs. Ogden, 9 Wheaton, i, 199.*

It should also be remembered that lotteries, if they exist at all in the United States, must do so under the authority of State laws; that Congress can not take from a lottery company the charter which a State Legislature has granted; or make the issue of its tickets illegal, or punish as a crime the action of the managers by whom the business of a lottery is carried on; and further, that any legislation to make lotteries illegal should inferentially pertain to the State; first, because no jurisdiction has been given under the Constitution to Congress, except by remote inference to interfere with this matter; and, second, because there is no doubt that there was a complete unanimity of opinion among its framers that lotteries were legitimate and unobjectionable instrumentalities of society, inasmuch as at the time the Constitution was framed they were authorized by the States and extensively employed throughout the country for the founding of schools and colleges, the erection of hospitals, and the construction of roads, bridges, and ferries. On the other hand, it does not admit of contention that under the exclusive power vested by the Constitution in the Federal Government to "establish post offices and post roads," the use of the mails for the transmission of lottery tickets and correspondence may be legitimately inhibited, or that the general business of lotteries may not be rightfully made subject to Federal taxation for the sole purpose of revenue. When the Provincial Legislature of Canada recently decided to suppress lotteries in the Dominion, the measures which it instituted for so doing were not made contingent in any way upon the power of taxation, but by the imposition of heavy fines and penalties, not only on those engaged in the business, but also upon those having lottery tickets in their possession.

During the early years of the late war, taxes were imposed on the circulation of the State banks, "manifestly with a view to raise revenue and inform the authorities of the amount of paper money in circulation, and for no other purpose." But in 1865 these taxes were greatly increased, not for revenue, but with the admitted intent of destroying all banking institutions chartered by the States, leaving only similar institutions chartered by the Federal Government in existence. The result sought was fully attained, and the constitutionality of the legislation by which it was achieved was subsequently affirmed by the United States Supreme Court, which in the case of Veazie *vs.* Fenno (8 Wall., p. 552) nevertheless held that "the States possessed the power to grant charters to State banks," that "the power was incident to sovereignty, and that there was no limitation in the Federal Constitution" of such power. But in delivering the opinion of the court, the Chief Justice (Chase) declined to enter upon an inquiry whether the tax imposed on the State banks was so excessive as

to divulge the legislative intention to prohibit banking on their part, but he argued elaborately that for another and stronger reason the tax could be constitutionally imposed because it was a tax levied for a lawful purpose, which lawful purpose was to restrain a State from interfering with the Federal control of the currency and the right of the national Government to emit bills of credit, and it was upon that point that the decision of the Supreme Court was in fact rendered.

The point of interest in this decision, however, is not the right of the Federal Government to regulate, especially under the original admitted necessity for the exercise of war powers, the currency of the country, but whether, having regard to the limitations on the exercise of the taxing power growing out of the nature of a constitutional government, the Federal authorities were justified in employing it as an instrumentality not to collect revenue but to prevent revenue, and when the desired end could be effectually achieved by other and unobjectionable methods; and on this point the court, following a well-established precedent of avoiding as far as possible all conflict between the judicial and legislative powers of the Federal Government, avoided any direct expression of opinion. As the case now stands, and as Congress has refused to discontinue the tax, it must be regarded as equivalent to an assertion that the Federal Government has the constitutional right to exercise the taxing power not for revenue and not by reason of any necessity that can justify it.*

During the recent discussion of the silver problem, an eminent American writer on economic questions recommended that a

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* Concerning the legitimacy and constitutionality of this procedure, a minority of the Finance Committee of the United States Senate, in a report in May, 1892, on a proposition to repeal this tax, expressed themselves as follows: Prior acts imposing taxes of one or two per cent on the notes of State banks, imposed for revenue purposes, the committee regard as entirely justifiable; but in respect to the ten-per-cent tax, which neither produced nor was intended to produce revenue, the committee say:

"This is flagrantly obnoxious in its manifest perversion of the taxing power conferred upon Congress by the Constitution. . . . We think also that a reasonable construction of the taxing power clause in the Constitution, to wit, 'the Congress shall have the power to lay and collect taxes, duties, imposts, and excises to pay the debts and provide for the common defense and general welfare of the United States,' would mean that Congress shall pay the public debt, provide for the common defense, and promote the general welfare with the money arising from such taxation, and not that Congress shall have the power to discharge these public duties by the mere framing of a statute without any revenue resulting therefrom. Surely it would be an absurdity for the Constitution to say that Congress shall have the power to discharge the debt of the United States by the mere framing of a statute or the wording of a law. The payment of money or the transfer of things of value is the only way by which a debt can be paid. Therefore the enacting of a law in the name and under the pretense of revenue which is intended to raise no revenue in fact, but which has another and entirely different object, is a gross and fraudulent perversion of the taxing power conferred by the Constitution."

Federal tax should be imposed on silver, varying from month to month according to the changes in its market price as bullion, with a view of establishing and maintaining a parity of value between gold and silver, with, of course, a total disregard of the sole object and justification of taxation—namely, revenue.

But the most curious illustration of the extent to which an entire misconception of the nature and functions of taxation has obtained favor in the United States is to be found in a pamphlet entitled Rational Principles of Taxation,* recently published by a Professor of Political Economy in the University of Pennsylvania, and included among the authorized publications of the university. In this the author advocates the levying of taxes by the national Government for the purpose of effecting "stability in prices"; and on the assumption that a large and increasing percentage of the national wealth is consumed in the expenses of the retail distribution of commodities, proposes to remedy the evil by imposing a discriminating tax on retail dealers so heavy as to crush out all such whose business and profits in a given time do not exceed a certain amount to be prescribed by statute. Among the anticipated advantages enumerated by the author of the adoption of such a scheme would be the saving of rent "on one half the stores" of cities and a great reduction of rent on the other half. "There would be little need of advertising; . . . the stocks of goods carried by the whole trade would be greatly reduced, from which there would be great saving of capital." But "perhaps the greatest saving of all would arise from the reduction of the force of salesmen and in the cost of delivering goods." And finally, carried away apparently by a beatific vision of the glories of such a tax millennium, the professor exclaims, "Think of all the elements of economy in conjunction, and an idea can be formed of the amount of taxes that could be levied on retail dealers without putting the public to any inconvenience!"† and "would not the unnecessary capital now absorbed in business be fully sufficient to furnish us with pure water, lovely parks, fine-art galleries," etc.?

PROSPECTIVE EVILS OF THE PERVERSION OF THE TAXING POWER.—In view of such experiences and propositions, the questions are most pertinent: How much further is such a perversion of the taxing power to be carried? And is not the entire recent experience of the nation in this respect in the direction of

* Rational Principles of Taxation. By Simon N. Patten, Professor of Political Economy, University of Pennsylvania, 1890.

† Obviously the author of this scheme supposed that the retail dealers of this country are such simple-minded people that they will cheerfully pay their proposed heavy taxes out of their capital, and not transfer them, through increased prices of their goods, to their consuming purchasers.

supplanting a "free" by a "paternal" government, which last in turn finds its highest expression in the enactment of sumptuary laws for the control by government of the private life of its citizens? All despotic power is alike in its nature; and, once indulged in, the results are always the same. Once let it be fully accepted as a legitimate feature of public policy that the great public power of taxation may be intrusted to individual hands for private purposes and the power of life and death will be promptly seized to make the former effective. Once confer upon government the power of dealing out wealth, and the day is not far distant when its recipients will control the Government, and by the use of money elect their magistrates and legislators to perpetuate this policy.

Had the framers of the Federal Constitution even so much as dreamed that the Government to be established under it would ever practically refuse to acknowledge any limitations on its right to interfere with the property of its citizens, would use the taxing power with undisguised intent for promoting private rather than public purposes, and would levy taxes to prevent the payment of taxes, the Constitution itself would never have been called into existence, and the great American Republic would never have had a history.*

AN OBJECT LESSON IN SOCIAL REFORM.

By FRANKLIN SMITH.

NO error is more prevalent among intelligent and well-read people than that the social philosophy of Herbert Spencer has little or no practical application to the modern problems of social reform. So deep-rooted is this error that the ablest religious journal in the United States, which gives much attention to these problems, once advised him to throw it away. Because he does not favor recourse to the state for purposes outside of the maintenance of justice, it could not conceive that his social philosophy provided in a more effective way for the solution of social problems. By an account of a homely instance of the application of this philosophy, I purpose to show how practical it is in the ordinary as well as extraordinary affairs of life—how it has no rival in the important and beneficent work of bettering the condition of mankind. The instance to which I refer is the method adopted

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in the city of Rochester, N. Y., to provide side paths along the country roads for bicyclists.

I.

In the early part of the present year the newspapers of the city made the surprising announcement one morning that there had just passed the State Legislature and been placed in the hands of the Governor for approval a bill to tax all bicyclists in Monroe County one dollar each, the fund thus raised to be devoted to the construction of side paths. I say surprising advisedly. Although it was afterward learned that seven or eight thousand bicyclists out of the twenty thousand in the county had signed petitions for the bill, scarcely any public mention of it had been made, and no public discussion of it had taken place. The newspapers went so far as to charge that it had been "sneaked" through the Legislature. While the charge was false, it illustrates for the thousandth time how important legislation may be had without the knowledge of the community it affects.

Besides an indiscriminate imposition of the tax on all bicyclists, whether living in the city or country, or whether they would have occasion or not to use the paths, the bill called into existence the customary political machinery to execute it. There were to be five side-path commissioners, appointed by the Board of Supervisors, and to serve five years. They were to determine the paths to be built, to decide how they should be built, to let contracts, and to issue orders on the county treasurer, the collector of the tax, for the payment of work. The most odious feature of the bill was the provision that the tax "should be a lien on the cycle taxed"; that in case of nonpayment the collector should "proceed to enforce said tax by seizing the cycle" and "selling the same at public auction to the highest bidder"; that the proceeds of such sale should be applied toward the payment of the tax and the incidental expenses, including the two-dollar fee to the collector.

In the heated discussion that followed the publication of these provisions, the usual arguments in favor of such legislation were brought forward. The most comprehensive as well as the most familiar was the "general-welfare" argument. This was the fine product of a clerical mind unable to appreciate the full significance of the golden rule and the commandment against covetousness. The argument of a distinguished physician, equally destitute of a keen appreciation of the rights of those bicyclists that might never have time to take an excursion into the country, was that "this plan is the only feasible solution of an extremely difficult problem." He said that it was "the outcome of careful consideration by the older and conservative wheelmen of the city, and not the scheme of the road riders, so called." He went to the extent of claiming most erroneously that "the opponents of the

bill admit that the raising of such a fund by voluntary subscription would be impracticable, and only through legislative action, authorizing the construction of such paths along our common highways by a small annual tax, can this much-needed public improvement be consummated."

A curious feature of the discussion, one common to the arguments of the most enlightened as well as the most ignorant that took part in it, was the amazing exhibition of selfishness, and of indifference to the rights of others. "The millennium is too far ahead," wrote another defender of the bill, impatient with the delay involved in voluntary enterprise, and convinced of the perfect propriety of coercing the bicyclists that did not care to contribute. "Only a few of the present generation of riders will be able to enjoy the full benefits of that network of good roads promised when that time comes. Our largest interest is in the present. We are selfish enough to want a few of the good things now that are sure to come in abundance hereafter." Then, to show how just the tax was, since it was levied on bicyclists only, and how glad they would be to pay it, since all were taxed alike, he added: "We only ask those interested to contribute their mite. Every wheelman will be willing to pay his tax if he knows that his neighbor, who is a wheelman, will do the same. When a rider tells me he is against the bill because he is paying for something he does not use, I know that it is the one dollar, not the man, that is kicking. Every rider will use the best path, whether it be a side path or a road. This is human nature." Alluding, finally, to the people willing to avail themselves of what he was pleased to call, with infinite scorn, "the free-lunch way of going through life," he said: "Could we get the free-lunchers to pay a dollar if they were not forced to? No; but they will use the paths just the same, and kick if they are not kept in good repair."

How often have these arguments been made to do duty for all sorts of schemes to promote "the general welfare"! How forceful and admirable they appear to the excellent persons that frame them! In the first place, the tax was such a little one; no one could be too poor to pay it. In the second place, people would be so delighted to pay compulsorily what they would not pay voluntarily! In the third place, could anything be more commendable than the suppression of "the free-lunch way of going through life," and the forcing of these odious "kickers" to pay for the paths they would be glad to have at other people's expense? Only one thing could be more commendable, and that is for those good people that want something done for their own benefit to pay for it themselves; only one thing could be more odious, and that is for these same people to get a law enacted to compel others to help

them pay for it. The philanthropists that advocated the bill could not see that they, in reality, were the "free-lunchers"; for they were not so much interested in the encouragement of generosity as they were to profit from it after it had been encouraged. It was not "the kickers" that needed reformation—it was the reformers themselves.

What such excellent persons need most is not more knowledge, as many reformers suppose, but, as Mr. Spencer has often pointed out, a livelier imagination and keener sympathies. Had the training of these faculties been more perfect, the proposed tax would have called to mind the hundreds, if not thousands, of poor owners of bicycles that had been forced to practice the most rigid economy to buy them—the shop girls, the mechanics and laborers, the servant girls and messenger boys, and the impoverished invalids advised to take exercise to restore health shattered by long hours in shops or stores. There would have been the feeling that to these unfortunates a dollar was a considerable sum, and that if it could not be paid, as the bill required, the cost and annoyance of the legal proceedings authorized for its collection would be a serious hardship. The possible sufferings of unfortunate delinquents, rather than the advantage of paths and the suppression of "free-lunchers," would have filled the mirror of consciousness. With feelings stirred by pictures of injustice and suffering, not unworthy of the best days of a feudal despot, the benevolent advocates of the bill would have opposed it with even greater energy and skill than they defended it.

Another curious fact brought out was the ignorance of many of the petitioners as to the true character of the bill. Until the objections to it had been set forth in the newspapers, they did not realize what they had petitioned for. Even then it was impossible for some intelligent persons to comprehend that the bill was an outrage. I remember talking with two or three lawyers about it. Both from a legal and moral point of view they thought it an excellent measure. Another professional man, one of the brightest I ever knew, pronounced it the most just and practicable that could be proposed. But in spite of these perverted opinions, the discussion evoked such indignation and opposition that the bill was rejected by the mayor and common council, whose approval was required to make it law.

II.

Now that the bill had been defeated in accordance with the social philosophy of Mr. Spencer, what, in accordance with that philosophy, was the next thing to be done? Was the construction of side paths to be opposed altogether? Were bicyclists to be deprived of this means of pleasure and rapid communication between

the city and country? If the view taken of Mr. Spencer's social philosophy by the journal mentioned had been correct, these two questions would have to be answered in the negative. Nothing would have remained for the bicyclists to do but to get along as best they could with the bad roads and shoestring paths that fringe them.

Happily, however, the view in question was incorrect. Mr. Spencer's social philosophy enjoins the importance of taking advantage of every improvement, whatever it be, that will promote human welfare. That bicycle paths are an improvement of this kind needs no argument. As already intimated, they facilitate communication; they encourage people that live in the city to visit the country, acquaint themselves with its charms, and take the exercise that the preservation of health requires. But Mr. Spencer's social philosophy teaches that the improvement shall be undertaken voluntarily by those alone that desire it. Not only shall they undertake it themselves, but they shall seek to persuade others to join with them. What Mr. Spencer's philosophy forbids is that they shall ever resort to the argument of coercion to secure the aid of others.

Hardly had the bill been defeated before its opponents began work in accordance with this salutary principle of social reform. Through their efforts there sprang into existence, as in physical evolution, the social organs required to meet the new social wants. Voluntary associations were formed in different parts of the city to collect money from those that wished to give, and use it in the construction of paths. But the first step was not encouraging; it was decidedly discouraging. The meeting called to form the first Side-path Association was not attended by more than six or eight persons. But they were interested in the cause, and they were determined to do what they could to further it. They organized, elected a president, a vice president, a secretary, and a treasurer, collected a small sum from those present, and decided to go to work at once. The discussion that took place disclosed the conviction that it was inadvisable to wait until a larger fund had been collected. A previous experience was a warning against it. A bicycle organization in the city had collected six hundred dollars for paths, but, instead of beginning work at once with this sum, it waited to raise more money, and while waiting the money already in hand went for other purposes. Another reason for immediate action was the belief that as soon as bicyclists saw that the new association "meant business" they would contribute. Each foot of path constructed would be convincing evidence of the sincerity and enterprise of the association and of the value of the work undertaken. It was not long before money enough came in for a mile of path. Soon,

too, two other associations were organized and began work in the same way.

The supreme merit of voluntary effort, as every careful student of Mr. Spencer's social philosophy knows, is the powerful stimulus it exerts both upon the generous emotions and upon the intellectual powers. People brought together by their interest in a common cause not only feel friendly toward one another, but by their desire to interest others in the same cause they are moved to be friendly with them. Most marked was the growth of this feeling among the bicyclists of the city and country after the defeat of the tax bill. It was often mentioned and commented upon. As a result of the desire to promote a common cause, contributions came in freely. They were not limited to the dollar fixed by the tax bill. There were several sums ranging from twenty-five to one hundred dollars. Nor did they come from bicyclists alone. People that never rode a wheel gave. Nor were contributions confined to money; they included cinders, ashes, and gravel for the paths and team work from farmers.

The invention of ways and means was quite as marked as the moral effect. Had the tax bill been passed, the bicyclists would have been just as indifferent to this subject as they would have been to one another. But the necessity of raising money by voluntary effort stimulated them to the discovery of the most effective ways. The women riders held a lawn festival, and raised some money; they gave an entertainment in a public hall and raised more. A newspaper was induced to undertake the collection of a fund. It was so successful that it obtained more than a thousand dollars. At the suggestion of a physician much interested in bicycle riding as a healthful exercise, a callithumpian parade was held in the driving park. Although the admission was only twenty-five cents, nearly twenty-five hundred dollars more were obtained. The result of the various methods for raising money was over five thousand dollars.

The best part of the defeat of the tax bill was the deliverance from politics and politicians. Here, too, was another application of the social philosophy of Mr. Spencer. How often has he shown that a more cumbersome, ineffective, and wasteful way of doing business could not be devised! Had the wit of man set about to invent something to dissipate energy, to stir up contention, and to produce the least satisfactory results, it could have hit upon nothing better adapted to this end than the tax bill. There would have been the intriguing for the appointment of the side-path commissioners; the scheming to get contracts for the construction of the paths; the pulling and hauling to have them constructed in some particular locality first; and, finally, the certainty that they would not have been built in the best and most economical way.

But in place of this mass of politics, inseparable from the state conduct of business, there was the natural selection of the most reputable and fit men to take charge of the work. One of them was an engineer of long experience in municipal works. Another was a contractor of more than usual character and ability. Still another was a banker, who was made treasurer, and who personally inspected the work before it was paid for. Still another was a man of wealth and leisure, who was glad to devote himself thus to the welfare of his fellows. All the other gentlemen that had anything to do with the work were likewise men of standing in the community. All served without pay.

The result of the selection of such men was the construction of the largest possible number of miles of path with the smallest possible expenditure. They exercised care in the purchase and use of material. They knew that they had but a limited sum of money to spend, and they aimed to make it go as far as they could and to build as good paths as they could. They avoided expensive experiments. They made sure, before going ahead, that the plan they had adopted was the best. How well they succeeded is shown by the fact that no fault has been found with their work. As the various paths were completed, the bicyclists of the city were invited to join in what was called an "opening." From five hundred to two thousand would meet at the entrance of the path and ride over it. In every instance they expressed satisfaction with what had been done. It had been estimated, while the tax bill was under discussion, that the paths would cost ten cents a running foot. By the plan thought to be so chimerical the cost was reduced to from two to four cents a running foot.

III.

What was done in this instance, where it was believed indispensable to summon the aid of the state, can be done in all instances. No practical problem of social reform has been or can be suggested that can not be solved by voluntary effort. To appeal to the state to solve it is to appeal to force, to resort to feudal methods. It is, moreover, to assume that I know better than my neighbors what will make them happy—that I have the right to compel them to make that use of their money that will add to my pleasure rather than to theirs. By the pursuit of this absurd policy, modern reformers, forgetting that they are following in the footsteps of the old French despots, imagine that they are hastening the millennium. What they are hastening is only a revolt against their suppression of freedom. They are building up a despotism of democracy certain to become just as hateful and intolerable as the despotism of autocracy.

BOTANIC GARDENS.

By D. T. MACDOUGAL,
ASSISTANT PROFESSOR OF BOTANY IN THE STATE UNIVERSITY OF MINNESOTA.

II.—TÜBINGEN AND ITS BOTANISTS.

THE botanic garden connected with the old Würtemberg University at Tübingen is worthy of special notice, because of its history and its importance as a center of research in the biology of plants at the present time.

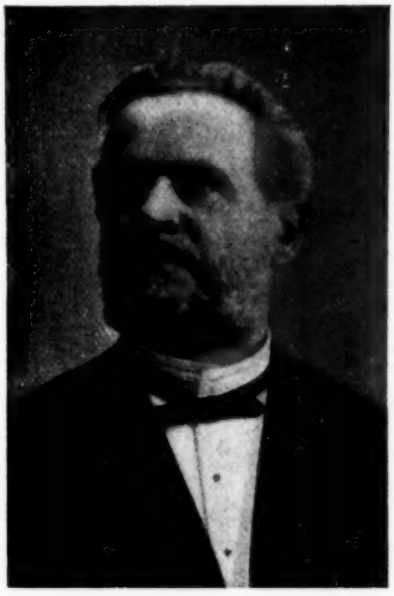
The university with which it is connected was endowed more than four hundred years ago by the reigning house of Würtemberg, and during the entire period of its existence it has enjoyed the exclusive patronage of the grand ducal and later the royal family, as it is the only higher institution of learning within the kingdom. Set as it is among a hardy and virile people, it has been the scene of many notable mental victories over tradition and superstition. It has always held a position in the forefront of human advancement, and its splendid achievements mark epochs in human thought. Here have originated great schools or methods of thought in the different branches of human knowledge. Bauer in philosophy and von Mohl in botany have each forwarded research in his respective line in a manner that can not be measured or easily estimated.

The subject of botany in this institution received its first attention from the side of medical science. With the introduction of the laboratory method of instruction, actual demonstrations of plants were used to supplement the lectures. To meet the need of material of living plants the garden was founded in due time, and it has at successive periods represented quite accurately the development and extension of botanical science,—a development to which the botanists of Tübingen have largely contributed. The subject of botany here has always been in the hands of workers of the first rank, who each in turn have materially advanced the frontiers of knowledge of the biology of plant life, for a period extending over three and a half centuries.

The first lectures on plants, dealing with their medical properties, were given at the university by Leonard Fuchs, from 1535 until his death in 1566, although it was not until a century later (1662) that the garden was founded. Fuchs occupied a prominent position in the history of ancient botany, since he made the first attempt to establish a system of terminology, and furthermore he was the first to base descriptions of species upon facts obtained from an actual examination of the plants themselves. In his *Historia Stirpium* about five hundred species are figured

and described, and the woodcuts in this quaint old herbal are of value even at this time. It is to be borne in mind, however, that Fuchs had formed no idea of the natural relationships of plants. The species given in the herbal are arranged in alphabetical order. It seems almost inconceivable at the present day, yet the descriptions of plants made by botanists in the period preceding Braunfels (1530) and Fuchs were not taken from nature, but were borrowed from still earlier writers, and supplemented by additions drawn purely from fancy and colored by the superstition of the time.

The establishment of the garden in 1662 was purely for the purpose of conserving medicinal plants, and only such species were cultivated as could be grown in the open air. The art of growing plants in artificially heated glass houses was not understood at that time. The garden occupied a plot of ground lying on the banks of the Neckar in what is now the heart of the city of Tübingen, where it remained until 1805, when it was removed to its present position.



SIMON SCHWENDENER, Professor of Botany and Director of the Botanic Garden, 1878. After a photograph by T. Barzuck, Berlin.

The lectures in botany in the university took on a new dignity when a separate chair was devoted to the subject by the appointment of Rudolph Jacob Camerarius as extraordinary professor and director of the botanic garden in 1688. He was afterward promoted and remained at the university until his death, in 1728. Camerarius made a most notable addition to botanical science by the actual experimental demonstration of the principal facts in the pollination of plants (1691 to 1694). Sachs says in his history of botany: "Camerarius had observed that a female mulberry tree once bore fruit, though no male tree (*amentaceis floribus*) was in the neighborhood, but that the berries contained only abortive and empty seeds, which he compared to the addled eggs of a bird. His attention was aroused, and he made his first experiment on another dicœcious plant (*Mercurialis annua*). He took, in the end of May, two female specimens of the wild plant (they were usually called male, but he knew them to be female) and set them in pots apart

from others. The plants throve, and the fruit was abundant and filled out, but when half ripe they began to dry up, and not one produced perfect seeds. His communication on this subject is dated December 28, 1691." The importance of his discovery was not recognized at the time, and his conclusions were accepted in a figurative sense only. Not until the end of the following century was his experimental evidence used as a basis for further researches by Kölreuter. Linnæus, to whom great credit is given by many writers for his share in the development of the theory of the sexuality of plants, ignored the facts disclosed by Camerarius, and arrived at identical conclusions in a purely deductive manner, arguing from the necessities of the case.

WILHELM PFEFFER, Professor of Botany and Director of the Botanic Institute, 1878–1887. After a photograph by W. Hornung, Tübingen.

After the demise of Camerarius he was succeeded by his son Alexander. Later the lectures on the subjects of botany and chemistry were given by one professor. After a short interregnum the subject was once more in the hands of a master spirit in the person of Joseph Gaertner, who was called to the chair of botany in 1760. Gaertner remained at Tübingen eight years, going to St. Petersburg to accept the chair of botany in 1768. He returned to Calwe in 1770, and published shortly afterward his *De Fructibus et Seminibus Plantarum*, which may be truly termed an epoch-making work. The study of fruits and seeds had languished for more than a century, and Gaertner came to it with a mind singularly free from prejudice. He was aware of the real value of fruits for the arrangement of plants in a natural system, but he did not attempt to found a system on such material alone. Having at hand a most extensive collection of plants from around the world, which he studied with a persistence that brought him nearly to blindness, his book is an inexhaustible mine of facts and a guide to the morphology of fruits and seeds. His collection of material and microscope are still preserved in the botanical museum.

The lectures in botany at the university were placed in the hands of Friedrich von Kielmeyer as professor of natural phi-

losophy in 1805. At this time the garden was removed to its present location, on the banks of the Ammer, in the northwestern part of the city, and shortly cold and warm houses for plants and a residence for the university gardener were erected. Kielmeyer was succeeded by Schubler in 1817, and he in turn by Hugo von Mohl in 1835.

It would be difficult to overestimate the value of the work accomplished by von Mohl during the thirty-seven years (1835 to 1872) in which he was professor of botany at Tübingen. This period does not include the entire time of his activity in this place, however. In 1826 the faculty of medicine offered a prize for an essay on the nature of tendrils and climbing plants, and a thesis by von Mohl, who was then a student, won the prize. This academic essay, written at the age of twenty-two, remained the clearest presentation of the subject until it was taken up by the elder Darwin in 1865. During the half century in which he was

HERMANN VÖCHTING (sitting, facing front) and Group of Workers in Botanic Institute in Summer of 1896; Professor of Botany and Director of the Botanic Garden since 1887. After a photograph.

a leading figure in the botanical world, he used a purely inductive method of research, and by a long series of many-times repeated observations established manifold phenomena and facts which he welded into a coherent mass by a logic so relentless that he was incapable of being led astray into fanciful theories and dazzling speculations. Such a method enabled him to take a prominent part in the destruction of the chimerical teaching of the nature

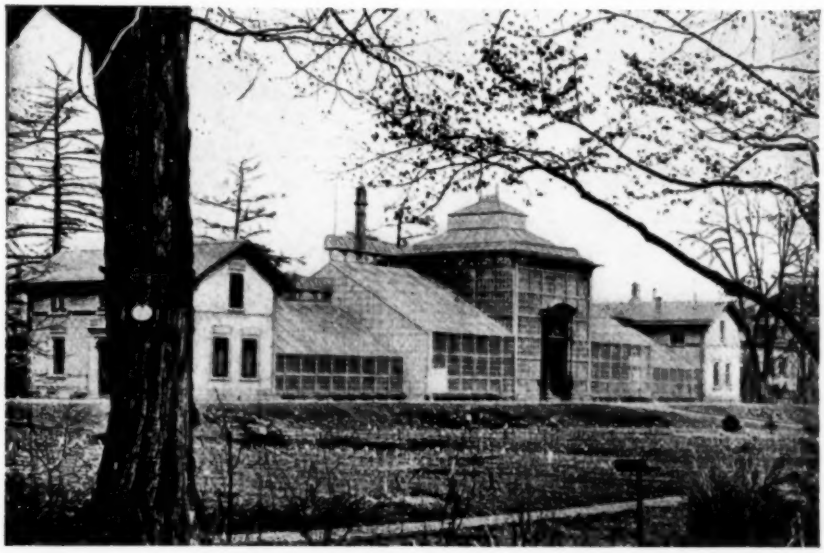
philosophy, especially in regard to the doctrine of the metamorphosis of plants. Furthermore, he succeeded in establishing the principles of anatomy so clearly that a rational system of morphology became possible for the first time. So important and basal were his demonstrations concerning the real nature of the primordial utricle that by many botanists he is said to have discovered protoplasm (1846). Von Mohl, with Schlechtendal, established the *Botanische Zeitung* in 1842. The list of his works includes ninety titles, embracing subjects in every department of the science. During his administration at Tübingen the garden was enlarged by three additions, to its present dimensions, occupying an irregular tract of land on both banks of the Ammer; important additions were made to the glass houses in the garden, and the institute building was erected in 1846. Perhaps no greater tribute can be paid to von Mohl's broad conception of the scope and needs of botany than the fact that this institute building erected fifty years ago, remains practically unaltered to the present day, and is still found fairly available for the purposes of modern investigation.

Upon the death of von Mohl, in 1872, he was succeeded by Hofmeister, who died after having held the post but five years. Hofmeister had perhaps accomplished his more important results before his stay at Tübingen. Like von Mohl, he used an inductive method of investigation, and he as well made enormous contributions to the material facts upon which many of our present generalizations in morphology rest. The results of the investigations published in his *Vergleichende Untersuchungen* in 1849 remain to-day superior to anything achieved in descriptive botany. To Hofmeister must be ascribed, among other important embryological results, the discovery of the alternation of generations in plants, and by the use of his phylogenetic mode of study the ideas concerning natural affinities of the groups of cryptogams and phanerogams underwent an almost total alteration. His establishment of the genetic relationship of these great subdivisions resulted in the overthrow of the prevailing belief in the constancy of species.

Prof. Simon Schwendener succeeded Hofmeister as director of the institute and garden in 1877. He, as well as his two successors, are still in the midst of active work, and it is by no means easy to forecast the final value of the results of their investigations upon the development of the subject. Schwendener has made very important contributions to the biology of lichens, phyllotaxis, besides a long series of contributions of the first rank in the domain of morphology and physiology. Among these his *Mechanische Princip in der Bau der Monocotylen* is of the greatest importance. Schwendener remained but a year at Tübingen, going

thence to the University of Berlin, where he vigorously continues his researches. In consequence of his short stay but little of his work was accomplished at Tübingen.

The direction of the institute and garden was assumed by Prof. Wilhelm Pfeffer in 1878, who remained in the place nine years. The splendid results accomplished by himself and students during that time are published in a set of two volumes entitled *Untersuchungen aus den botanische Institut zu Tübingen.* The work dealt with the principal problems of physiology in growth, turgescence, secretion, movements, respiration, and nutrition. In 1887 Pfeffer removed to Leipsic. Both before and after his stay



VIEW OF PALM HOUSES, WORK ROOMS, AND HERBARIUM, IN AUTUMN. After a photolithograph in "Die unter der Regierung seiner Majestät des Königs Karl an der Universität Tübingen errichteten und erweiterten Institut der naturwissenschaftlichen und der medizinischen Fakultät," 1889. By permission.

at Tübingen he made most important contributions to the science, especially with regard to the physical and chemical properties of plant tissues, notably in osmosis and turgidity, and also in the transformations of energy within the organism. His laboratories and lecture room are thronged with students from all over the world, many of whom are Americans.

The present director of the institute and garden, Prof. Hermann Vöchting, succeeded Pfeffer in 1887. Prof. Vöchting may be said to be to some extent a representative of the modern idealistic school with which Braun, his old teacher, was identified. His work, however, resembles that of the idealists only so far as to exhibit the immense value of comprehensive discussions of the results of careful inductive inquiry, not only in the establishment

of individual facts, but in the employment of these facts in their relations to the most general notions and their capabilities for the foundation of new and more comprehensive theories—a method of investigation productive of the highest results in all departments of biological science. One of the conclusions reached in this manner, which asserts the "polarity" of the plant cell, is at present beyond the general level of the subject. Polarity will doubtless be recognized as one of the most important physiological properties of protoplasm when the advance of the subject makes its appreciation possible. The researches of Vöchting have dealt prin-

THE BOTANIC INSTITUTE, VIEW FROM WILHELMSTRASSE.
After a photolithograph, by permission.

cipally with the physiology of movement and what might briefly be termed physiological morphology.

The garden is located in the northeastern part of Tübingen in western Würtemberg. It lies at an elevation of about one thousand feet, on the plateau encircled by the Schwarzwald, in latitude 48° 30′ north. Near it are hills covered with forests of pine, which rise two hundred and fifty to three hundred feet above it, while to the southward, twenty miles away, the Swabian Alps reach to a height of twenty-five hundred feet, in consequence of which the night temperature falls far below that of the day. A low winter temperature of −30° C., and a summer limit of 25° to 28° C., help to make a climate which resembles that of southern Michigan in many respects. The area inclosed amounts to about two and six tenths hectares of nearly level land on both sides of the banks of the Ammer, a small tributary to the Neckar. The grounds are planted in the system of Eichler, modified, however, to meet the

ecological and æsthetic requirements. A small portion is devoted to aquatic plants, a second to an arboretum, another to an experimental plot inclosed and accessible only to workers. In the entire garden the instinctive ability of the naturalist is shown in the selection of natural conditions for the specimens of the various flora represented, and the alpinum may be regarded as a triumph in the art of artificial culture.

The alpinum is laid out in the northwestern part of the garden on a rectangular plot of ground one hundred and ninety feet in length and nine feet in width, near a stone wall seven feet high and parallel to its length. On this plot are piled the rocks and soil necessary for the culture of plants, in an uneven ridge, which in one place is six feet in height. The materials used were principally the native stalactite limestone and gravelly soil and granite from the Black Forest, forty miles distant. The limestone is peculiarly suitable for the lower Alpine plants and lithophytes, furnishing, as it does, innumerable cavities for the reception of soil and secure foothold for plants which cling directly to the rock. It has been found that the species from the higher European Alps refused to grow on such rock, and hence the granite was procured for the section devoted to this group. The entire structure is in many respects an admirable imitation of an east-to-west mountain ridge. The northern side affords many shaded crevices, and more or less shade to the whole is given by a number of small trees near by.

The most difficult problems which have confronted the gardener in the construction and management of the alpinum have been those connected with the water supply. The water content of such rocky soils is of course extremely small and needs almost constant replenishment. In Nature this is done by water from the melting snows above. Here it has been accomplished by a system of branching pipes with many openings below and above the surface, and a flow is allowed during the greater part of the day. The drainage is carried away by cement conduits, and in one place forms an Alpine lake eight feet in length and five feet in width, which furnishes in its waters and on the overhanging cliffs admirable conditions for a very rich flora. Near the lake are growing several specimens of Edelweiss, which here becomes somewhat longer stemmed than on its native cliffs, or in the Alpine gardens where it is cultivated to satisfy the thirst of the tourist for mementoes of "hazardous" ascents.

Many of the Alpine plants are quite intolerant of lime salts and grow best on the granite rocks, but the water supply used here is taken directly from the city system and is very richly charged with these substances, and as a consequence the culture of some of the plants of the higher slopes is impos-

sible. This difficulty might only be overcome at some cost by a system of tanks for the storage of rain water, which would furnish exactly the natural conditions for a large number of species.

It is somewhat surprising to learn that in this area of about two thousand square feet more than twelve hundred species are successfully cultivated, almost all of which are perennials. In some places three or even four kinds are grown on a square foot of actual surface—a striking example of a form of intensive cultivation. It must not be supposed, however, that none but Alpine species are grown. A glance at the labels will show

CORNER OF LECTURE HALL; VIEW FROM GARDEN. After a photograph.

that many are at home far southward in the temperate zone. It is interesting to note that all of the North American species of *Cypripedium* are grown here successfully. As a matter of fact the alpinum offers a wider range of conditions than any other method of cultivation, and in some form similar to that described might offer suitable conditions of growth for species fairly representative of the flora of a region extending across twenty degrees of latitude.

The glass houses are of the usual form, and include a palm house two hundred feet in length, to which are attached workrooms and the herbarium building. The immediate supervision of the cultural department of the garden is in the hands of the head gardener, who is provided with a commodious dwelling and office building near the arboretum. He has under his direction a

force of men varying from eight to fifteen with the requirements of the season.

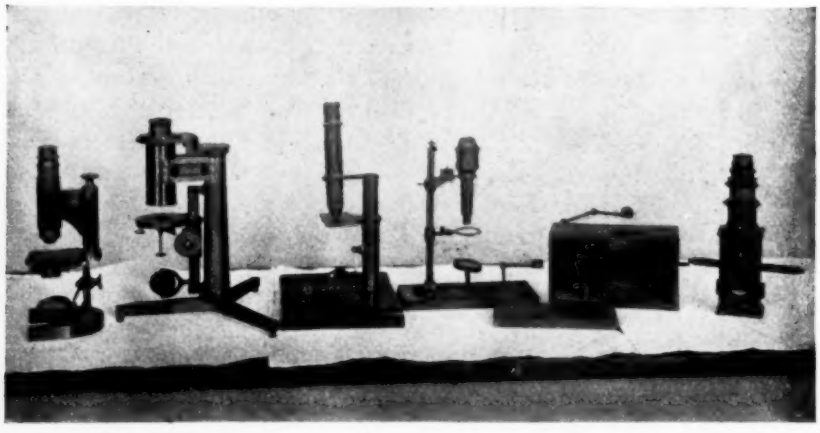
The institute is an oblong brick structure, one hundred and seventy feet in length by sixty-five in width, standing in the southeastern corner of the grounds. This building is two-storied in part, the second story being devoted to the use of the director and his family. The first floor accommodates the director's offices, private laboratory, and experimental rooms, dark rooms, laboratories for physiology and morphology, the lecture room, and a museum containing the Gaertner collection.

The laboratories are supplied with a set of physiological apparatus embracing the standard forms, a large number of which were originally designed to facilitate researches undertaken here in the last twenty years. The museum contains the von Mohl collection of microscopes, which represents the development of this instrument from the time of Joseph Gaertner to that of Hofmeister, more than one hundred years. The Gaertner museum contains the carpological collections of Joseph Gaertner, on which his work *De Fructibus*, etc., was based, in the labeled bottles as prepared by him. For greater safety these bottles were inclosed in larger bottles and labeled by von Mohl, and the thoughtful observer looks forward to the time when a third casing of glass will be added to protect the prized handwriting of von Mohl. In this museum are also to be found the dried specimens of hybrids and seeds, drawings, manuscripts, and published works of Karl Friedrich Gaertner, and a large number of preparations for the microscope made by von Mohl and Hofmeister. The commodious lecture room is provided with all necessary appliances for successful demonstrations—charts, prepared specimens, wood and paper models, etc.

The investigator who comes here to undertake the solution of some problem in botany meets a body of congenial workers whose earnest enthusiasm is quickly contagious. He is furnished with ample space in well-lighted rooms and any necessary apparatus. If it is necessary to construct temporary apparatus to carry forward his experiments, a stock of material is at hand and he may have the intelligent assistance of the "Hausmeister," who has had a score of years of experience in such work in this institute. If the problem requires the application of delicate or complex machinery, he may call to his assistance Herr Eugen Albrecht—"Universitäts-mechaniker"—whose skill in designing effective apparatus for use in the physiology of plants and animals is known round the world. The library of the institute and that of the director contain a large number of works of the more prominent botanical authors, and a blank form properly filled will bring to his desk almost anything bearing upon his work from the

library of the university, containing two hundred thousand volumes, in an hour or two. Outside the laboratories lies a garden stocked with an immense variety of well-grown plants representing great diversities of form and habitat, and presenting suitable material for the solution of a number of the more important open questions in the subject. Stretching away on every hand is the rich flora of the limestone hills, crested by coniferous forests. The subalpine vegetation of the Swabian Alps may also be reached by an excursion of a few kilometres.

The forests, lying within half an hour's walk of the garden, embrace examples of the royal, communal, and private systems



GROUP OF MICROSCOPES FROM THE VON MOHL COLLECTION. The upright wooden stand on the right was used by Gaertner. The modern form on the left belonged to Hofmeister. The remaining stands were designed or used by von Mohl. After a photograph.

of management, and afford splendid opportunities for study in dendrology.

The most valuable part of the worker's experience, with such ample facilities at hand, however, is that which comes from the advice, encouragement, and suggestions of the director. Constantly engaged in the most laborious research for more than a quarter of a century, he has a vivid and sympathetic appreciation of the difficulties which beset the investigator, and his keen insight into the physiology of plant life leads him quickly to the solution of the problem in hand. His time and patience are unstintingly given to any who may have the slightest claim upon them, and the many times repeated assertion that the German professor gives a minor portion of his time only to his students is certainly ungrounded here. The writer is not acquainted with any American laboratory for botany in which the professor in charge devotes a greater proportion of his time to the student. In earlier times the Tübingen professors carried

this devotion to the interests of the student to such a degree that it amounted to a fault, and published their own researches under the names of their students. This generous, unselfish, and high-minded attitude is an inheritance in the Botanic Institute at Tübingen, and is characteristic of the people among whom it is situated.

OUR PRESENT KNOWLEDGE OF THE ANTARCTIC REGIONS.

By Prof. ANGELO HEILPRIN.

IT can safely be said that we to-day know less about the antarctic regions than of any other portion of the earth's surface. We speak vaguely of an antarctic continent stretching across the southern pole, and some have even gone so far as to locate its boundaries, and to give an estimate of its superficial area. This has been placed almost anywhere between four and six millions of square miles—therefore larger than, or nearly twice the size of, the semi-continent of Europe. But no one is in possession of the facts which would prove the existence of such a continent, although it is by no means unlikely that it exists; and if it does, we know practically nothing of the possibilities of its flora or fauna. Up to the beginning of the past year perhaps the most striking definition that could be given of so-called Antarctica was that it was a region whose land area was entirely destitute of a flora and of a strictly terrestrial fauna. Not a vestige of moss, not a shred of lichen had up to that time been discovered; not an animal, excepting aquatic birds, had been found to give life to the few patches of open country that had been seen, or to the ice that almost everywhere covered it. The observations of the Norwegians Kristensen and Borchgrevink, made in the early part of 1895, to an extent modify this dreary conception, for at least one form of cryptogamous vegetation has been found within the Antarctic Circle—on Possession Island and on the opposite Victoria Land, near Cape Adare.

If we bar out the work of the past three years (1893–'95) it can be said that nearly all the knowledge that we possess of this Antarctica dates from a period a half century back and more—to the period of the researches of Bellany, Biscoe, Dumont d'Urville, Wilkes, and Sir James Clark Ross, and to no explorer are we indebted for more information than to the last-named. These investigators have determined the existence of certain patches of land, in most cases defined by prominent mountain swellings, which appear here and there behind a great barrier or wall of ice, to which the name of "Antarctic Barrier" has generally been given.

Such land areas—perhaps not in all cases positively demonstrated to be distinct from sea ice—are Victoria Land (due south of New Zealand), Wilkes Land (not improbably a series of island elevations opposite Australia, and known under the various names of Adélie Land, Clarie Land, Sabrina Land, etc.), and Graham Land (somewhat east of south of the extremity of South America). The most extended piece of coast or land line is that which has been traced southward in Victoria Land by Ross from about the seventieth to the seventy-ninth parallel of latitude, or over about six hundred geographical miles. It is only here, and in Graham Land (with the adjoining parts of Palmer Land, Louis Philippe Land, Joinville Island, Alexander Land), that our knowledge becomes at all definite.

Ross found the whole eastern coast front of Victoria to be paralleled by one or more mountain ridges of very considerable elevation, and bearing upon themselves a large number of clearly defined volcanic cones. Mount Melbourne, seemingly the highest point (with an elevation of nearly fifteen thousand feet), is described as having a prodigious summit crater. Mount Erebus (12,400 feet), the most southerly of all active volcanoes, was in violent eruption at the time of Ross's visit (January, 1841); a little to the east of it (in approximately latitude 78° 30′ south) is the extinct cone of "Terror," 10,900 feet. Beyond Mount Terror the Parry Mountains, also of very considerable elevation, and which continue to be the most southerly piece of land area that has ever been sighted, follow the generally southern trend to at least the seventy-ninth parallel of latitude, and not impossibly for a long piece beyond.

Geographers who define the contours of the presumed antarctic continent usually deflect its course eastward beyond Mount Terror so as to make it conform to the east-and-west ice barrier which barred Ross's passage farther southward; but it is significant that Ross says, "If there be land to the southward [of the barrier], it must be very remote, or of much less elevation than any other part of the coast we have seen, or it would have appeared above the barrier." This statement becomes of special importance, because elsewhere the land was clearly defined by its mountains at distances of ninety, one hundred and thirty, and even one hundred and fifty miles.

The region explored by Ross has only once been visited since —by Kristensen and Borchgrevink and their associates of the Antarctic. The Antarctic succeeded in following the route of Ross to about the seventy-fourth parallel of latitude, when, with open water still to the south, a return was made, owing to an absence of whale supply. Few facts of any consequence were added by this journey, the most important being, perhaps, the discovery

of shreds of lichen on Possession Island and on the mainland of Cape Adare opposite, this being the first landing on what may properly be designated mainland. Borchgrevink confirms in almost every particular the observations of Ross, and from the two accounts we learn that Victoria Land is a region of lofty mountains, largely and perhaps almost entirely of a volcanic nature, and almost entirely buried within a mantle of snow and ice. The covering of snow and ice is not sufficiently massive to obliterate the relief of the land—differing in this respect from the interior of Greenland—and the contours of valley and mountain are well and clearly retained. Giant glaciers descend toward and into the sea, terminating in vertical cliffs of ice of one hundred, one hundred and fifty, and two hundred feet in height. A vast ice barrier of vertical cliffs, whether of glacial formation or otherwise, and retaining a nearly uniform elevation of one hundred and fifty to two hundred and fifty feet—with a reduction at one point to nearly eighty feet (or less)—defines a considerable part of the north and south coast line; beyond the seventy-eighth parallel of latitude this ice barrier trends eastward for at least three hundred miles, but it is not known that any approximate coast line lies back of it with a similar trend.

Westward of the one hundred and seventieth parallel of east longitude, and situated close upon the Antarctic Circle—now to the south of it, then to the north—and forming, as it were, a continuation of Victoria Land through some seventy degrees of longitude, are a number of designated land patches (such as Clarie Land, Adélie Land, Sabrina Land), which, with the uniting ice-cliff barriers, constitute the coast line of the antarctic continent of Wilkes—sometimes also known as Wilkes Land. How much of this continuous frontage of some two thousand miles is really land no one knows. The mountain undulations mark some parts as being indisputably such; yet a reasonable doubt may be entertained regarding some of the presumed land masses of Wilkes, and it is known that one of his mountain chains was sailed over by Ross in the region of the Bellany Islands. A reference likewise to the admirable illustration of Clarie Land in D'Urville's monumental work on The South Polar Regions makes one suspicious as to the true nature of this *côte*, and forces one to inquire if it is not merely a portion of the great Antarctic Barrier.

Still farther west lie Kemp Land (probably island) and Enderby Land or Island, and finally, almost due south of the South American continent, the complex of Graham and Palmer Lands, with Terre Louis Philippe, Isle Joinville, and the more recently discovered or named King Oscar II Land, which was traced in 1893 by Larsen to nearly the sixty-ninth parallel of latitude, he himself attaining 68° 10′. This series of lands, which are closely con-

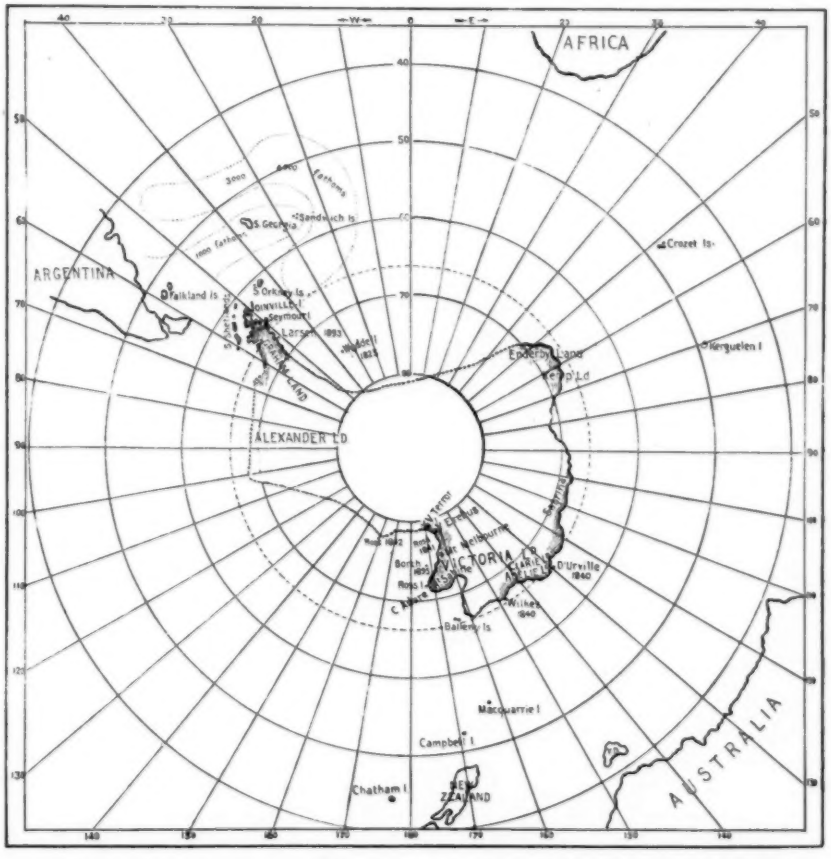
tiguous with the South Shetland Islands, is also loftily mountainous, ranging to perhaps nine thousand feet, and with volcanic cones as a dominant feature. Lying east of King Oscar II Land, which is seemingly only a portion of Graham Land, are a number of small islands, some of which, as Christensen and Lindenberg, were volcanoes in active eruption at the time of Larsen's visit. This tract of archipelago lying south of the American continent is much less snow-bound than the region about Victoria Land, large areas of bare rock being exposed both on the islands and on the mainland, especially the volcanic slopes. Not improbably the heat of the volcanic cones has much to do with keeping an exposed surface, although it can hardly be supposed that this exposure is entirely due to this cause.

The geographical and geological study of the region under consideration resolves itself into four or more lines of inquiry: 1. Have we a continent in Antarctica? 2. What is the nature of the ice covering? 3. Of what construction are the rock masses? 4. Has Antarctica ever been united with any of the major divisions of the earth's surface which we recognize as continents?

The first inquiry hardly recognizes a positive answer as yet. Wilkes was certain that in the land masses seen by him, or thought to have been seen, we had the positive marks of a vast united continent; Ross, although he had seen more continuous coast line than any other investigator, was exceedingly doubtful on this point, and considered the evidence insufficient for positive determination; Murray, the distinguished geographer of the Challenger Expedition, has gone even beyond Wilkes, and constructed the contours of what appears to him to be true Antarctica, the outlines of which are in the map on the next page. These may be approximately correct or not—a matter about as difficult to disprove as to prove—but it is certain that the materials upon which this construction is based are hardly sufficient to warrant the mapping. Yet it is almost positive that a vast land area—perhaps two, three, or more of them—underlies the capping of snow or ice; but whether it is entitled to the designation of continent remains to be demonstrated by future exploration. Ross strongly emphasizes the doubt as to whether all the eminences or appearances reported to be land are really such, and he himself admits—cautious observer though he was—to having been deceived on more than one occasion. Murray, again, warns us that much of the ice barrier described by Wilkes is not the true barrier (which is presumed to be the boundary to a not distantly lying *terra firma*), but merely the cemented pack. It is a significant fact that none of the explorers refer to a distant elevated ice cap, such as everywhere bounds the horizon of the observer looking

into Greenland, or to a mountain chain which is far removed from what is assumed to be the continental border.

The ablest discussion of the physical and geographical relations of Antarctica is furnished by the late Dr. Petermann in the *Mittheilungen* of 1863. He there argues strongly in favor of at least a partially open South Polar Sea, whose position is located central to the great ice masses which radiate out from it, and in



SKETCH MAP OF THE ANTARCTIC TRACT, GIVING THE MORE IMPORTANT POINTS THAT HAVE BEEN NAMED BY NAVIGATORS.

seasons of disruption—the months of November to April, the southern summer—press northward as the great Antarctic Barrier, the circle of pack ice which at varying latitudes has been the bar to passage of the different exploring expeditions. The special reasons advanced for this construction of the antarctic region are essentially two: (1) The comparatively low summer temperature of the south as compared with that of the arctic regions, an indication of oceanic rather than of continental conditions; and (2) the irregularity or instability of the pack ice, the front varying in

position (in a north-and-south displacement) by hundreds of miles. Thus, in approximately the meridian in which, in 1823, Weddell reached the surprisingly high latitude of 74° 15′ south, the famous navigator Cook, nearly half a century earlier, was stopped in latitude 60°; and in 1855 Captain Grant found himself confronted by the impenetrable flat-topped barrier, three hundred to five hundred (?) feet in height, in latitude 56° 50′—40° west longitude. Both of the arguments here stated have their force, but in how far they prove their case future exploration or penetration alone can show. Ice movements similar to those of the south take place in the arctic regions, and they are largely determined by the winds and currents which sweep over or govern a virtually open sea; but it should be noted that the ice pack of the north is very different from what is commonly designated the "barrier" of the south, with its stupendous wall precipices of one hundred and fifty to three hundred (or five hundred ?) feet elevation; such fronts in the arctic regions belong exclusively to isolated icebergs or to the terminal faces of ice sheets (glaciers) which debouch into the sea and terminate at no great distance from the mainland. The bounding ice walls of the northern face of Melville Bay are examples of this kind. The main pack, or that which blocks navigation in the north, is a surface, regular or irregular, which rises but little above the level of the sea, except where it is tossed up into shingles and hummocks, or into those irregular eminences which have been by some identified with the so-called "palæocrystic" ice. On the other hand, a counterpart of the southern barriers is to be found in the land terminations of some of the giant glaciers of the interior, whose "Chinese walls" have been so graphically described in the explorations of Grinnell and Grant Lands (Greely).

It is unfortunate that the term "Antarctic Barrier" should ever have come into use, as it has been made to cover a variety of structures, and has led to confusion in the interpretation of the special features which it designates. There is no question, as Murray has pointed out, that much of the so-called "barrier" of Wilkes is merely ordinary pack ice—some of it, indeed, in the brash or broken condition; therefore, considerable allowance must be made in the acceptance of that assumed girdle which is supposed to define a continent. A point that probably favors the (Petermannian) view of partially oceanic conditions within the ice is the presence of strong northwardly trending currents, which have been observed by both earlier and later explorers. Thus, at his farthest southing, in 1894–'95, in latitude 74° 10′, Captain Kristensen, of the Antarctic, met with such currents trending almost due northward opposite Victoria Land, and the question naturally suggests itself, Is this a direct current, or one that is

deflected northward after taking a westerly course along the edge of the southern barrier of Ross?

Of the arguments that have been advanced in favor of considering Antarctica as a vast continent buried deep beneath its covering of snow and ice, the most plausible are those which relate to the construction and form of the oceanic bottom within the region of the southern ice and the character of the ice itself. More explicitly stated, they are: (1) The shallowing of the sea toward the so-called antarctic tract—an approach to the borders of a continent—and the occurrence of what are stated to be subcontinental or terrigenous deposits, conditions that are well emphasized by Murray; and (2) the heavy massing of ice, which could seemingly not be other than of glacial origin. Ross found the depth of water opposite the barrier which stopped his farthest passage southward reduced to two hundred and fifty and one hundred and fifty fathoms, so that manifestly there was here a true shallow; somewhat similar results were obtained at a few other points along the barrier front. But it can be pertinently asked, In what special way would the approaches to an archipelago differ from those of a continent? With this special evidence of shallowing before him, Ross still believed in the probability of non-continental conditions, and he was in a measure justified in his belief by the fact that at many other points not far from the front of the barrier the lead indicated depths of from four thousand to six thousand feet, and even more.

The massiveness of the ice is in a condition which, so far as it is known to us, belongs exclusively to glacial formation; i. e., none but land ice is known to assume this form. The evidence which it offers, therefore, favors the notion of the existence of large terrestrial areas or gathering basins. Yet it is by no means impossible, or even improbable, that with the low summer temperatures which prevail in the antarctic tracts and the continuousness of fogs and clouds, the surface of the sea might of itself, through ages of precipitation and of comparatively little melting, build itself up in mountains of ice, hundreds or even thousands of feet in thickness. This view has, indeed, been held by some physicists, and no facts that are accessible to us are really incompatible with it. The uniformity of the table surface of the ice, which appears to be uninterrupted in places for hundreds of miles, combined with the fact that it only occasionally shows an undulating or rising surface back of it to mark out a land relief, is in itself a suspicious circumstance. This is very different from what we find in Greenland, the largest area of positive glaciation with which we are acquainted, and which certainly carries with it the constructional type of a continent. Whether seen from the east, south, west, or northwest, the relief line is

plain and continuous, and over the greater part of it, in clear weather, the great dome of receding ice-cap is well visible. And yet from this ice accumulation hundreds of glaciers are given off whose terminal or sea walls are of much the same height as the greater part of the Antarctic Barrier. Naturally, it can be assumed that Antarctica is much less mountainous than Greenland—may, in fact, be a gently rising or almost flat plain—and that the great length of its glaciers, which marks off a termination possibly a hundred miles or more distant from the actual border of the land, is that which prevents the land contours themselves from being seen. But are there just grounds for a contention of this kind?

The distinctiveness of the antarctic climate as compared with the arctic is found in the relations of both the summer and the winter temperatures. The high summer heat of the north, which in the few months of its existence has the energy to develop that lovely carpeting of grass and flowers which gives to the low-lying lands even to the eighty-second parallel of latitude a charm equal to that of the upland meadows of Switzerland, is in a measure wanting in the south; in its place frequent cold and dreary fogs navigate the atmosphere, and render dreary and desolate a region that extends far into what may be properly designated the habitable zone. The fields of poppies, anemones, saxifrages, and mountain pinks, of dwarf birches and willows, are replaced by interminable snow and ice, with only here and there bare patches of rock to give assurance that something underlies the snow covering. Man's habitations in the northern hemisphere extend to the seventy-eighth parallel of latitude, and formerly extended to the eighty-second; in the southern hemisphere they find their limit in Fuegia, in the fifty-fifth parallel, fully three hundred and fifty miles nearer to the equator than where, as in the Shetland Islands, ladies in lawn dresses disport in the game of tennis. And still seven hundred miles farther from the equator, in Siberia, Nordenskjöld found forests of pine rising with trunks seventy to one hundred feet in height. Yet it must not be supposed that there are not, as is perhaps commonly assumed, gleams of warm sunshine in this inhospitable south; indeed, we have yet to learn to what extent the far south is warm or cold. Thus, Captain Kristensen, the gallant commander of the Antarctic, who made the first landing on what is assumed to be the mainland of Antarctica, asserts that on January 5, 1895, when nearly on the sixty-eighth parallel of latitude, "the sun at noon gave so much heat that I took my coat off, and the crew were lying basking in the sunshine on the forecastle" (Transactions of the Royal Geographical Society of Australasia, Victorian Branch, March, 1896, page 87); and Biscoe, writing on the 16th of January, 1831 (on

approximately the sixtieth to the sixty-third parallel of latitude), states that "the temperature of the water was 34°, of the air in the shade 45°, in the sun 77°, with a corresponding general warmth to the feelings of the crew." The highest reading of the thermometer for the month of January was noted by Kristensen to be 40° F., and the lowest, 27°; fifty-three years earlier (1842) Ross found for the same month 39° and 27·5°, with a mean of 32°, thus indicating an equality almost without fluctuation.

The fact that the high south has not yet been penetrated in the winter months leaves us in uncertainty as to the winter temperatures that may prevail there; but some indications of this temperature are to be found in the records which have been obtained in the circumantarctic tract. Ross registered the absolute minimum, for the year 1842, in the Falkland Islands to be only 19·2° (−5·7° R.); but still more significant is the reading of the minimum thermometer which was left by Foster in 1829 on Deception Island, and recovered by Captain W. H. Smiley (as reported by Wilkes) in 1842, or after an interval of thirteen years. The registry was found to be −5° F. (−16·45° R.). It is true that Deception Island lies well without the Antarctic Circle, and that its insular condition must measurably reduce the rigors of a winter climate; but even these conditions permit us to form some just estimate of what "lies beyond," and of making some interesting comparisons with corresponding localities (so far as latitude is concerned) in the north. Thus, at Fort Reliance, in North America, the mercury descends to −70° F., and at Jakutsk, in Siberia, nearly one degree nearer to the equator, to −75°; and, if we are to fully believe the registry at Verkhojansk, for the winter of 1893, the unprecedentedly low temperature of −90° was reached. But one need not make comparisons with these especially cold localities, as it is well known that at the sites of the principal commercial cities of the world the mercury at times descends to from −5° to −15° (New York and Philadelphia, 1866, 1895). On January 23, 1823, the mercury in Berlin descended to −31° F., and in Paris, on January 25, 1795, to −21°. It is perhaps just to conclude from these and other facts that the extreme winter climate of the Austral Ocean, on or about latitude 63° south, is no more severe than that of southern France, and hardly more so than that of northern Italy. And while it is doubtless true that a considerably lower marking of the thermometer would be found in the much more extreme regions of the south, or nearer to the pole, it is practically certain that nothing comparable to the cold of the opposite face of the globe exists.

In summing up the various facts that have been noted, it may be admitted that they argue rather against than in favor of continental conditions, but they are by no means sufficient to make a

demonstration; indeed, the fact that such a large mass of apparently continuous ice exists circumpolarly speaks against the conclusion, and it is probably the one most significant circumstance which has led to favor the view of continentality. It must be observed, however, that the continuousness of the so-called antarctic continent rests upon somewhat insecure and far from confirmatory evidence. The open sea (with only three ice islands visible from the mast) that confronted Weddell at the seventy-fourth degree of latitude speaks volumes in its own behalf, and is evidence of a kind which is rather strengthened than otherwise—as proving the insularity of the ice—by the subsequent findings of Biscoe, D'Urville, Ross, and Grant, who found it impossible to penetrate to within eight hundred or a thousand miles of the position reached by Weddell.

In the same year with Weddell, Captain Benjamin Morrell, Jr., sailing from New York, reached in Weddell's track (March 14th), latitude 70° 14′ south, and he also describes the sea as being "entirely free of field ice," and stated that "there were not more than a dozen ice islands in sight. At the same time the temperature both of the air and the water was at least thirteen degrees higher (more mild) than we had ever found it between the parallels of sixty and sixty-two south. We were now in latitude 70° 14′ south, and the temperature of the air was 47°, and that of the water 44°."* Morrell significantly adds, "I have several times passed within the Antarctic Circle, on different meridians, and have uniformly found the temperature both of the air and the water to become more and more mild the farther I advanced beyond the sixty-fifth degree of south latitude"; and further: "I regret extremely that circumstances would not permit me to proceed farther south, when I was in latitude 70° 14′ south, on Friday, the 14th day of March, 1823, as I should then have been able, without the least doubt, to penetrate as far as the eighty-fifth degree of south latitude" (*op. cit.*, page 67).

Not much weight can be attached to the latter part of this statement, as it is well the experience of polar navigators how suddenly the presumably "open seas" close up; yet it would be nothing short of an assumption to place a barrier where it has in fact not been seen to exist. The circumstance that navigators who have followed Morrell found impenetrable barriers north of Weddell's and Morrell's positions is no evidence of what lies southward of them, and so far as anything that we now know of to the contrary, King George IV Sea may extend quite to or even across the pole. Both Weddell and Morrell experienced winds from the south in this water; the former, writing on the 18th of

* Morrell. A Narrative of Four Voyages to the South Sea, 1832, p. 66.

February, remarks: "Not a particle of ice of any description was to be seen, the evening was mild and serene, and our situation might have been envied had it not been for the reflection that probably we should have obstacles to contend with in our passage through the ice northward." As regards the various eminences which have at different times been designated "land" (such as Kemp Land, Enderby Land, etc.), and which have so often been united together to form a continuous land mass, there is every reason to believe that many of them are merely islands, and even islands of inconsiderable extent. Thus, it is certain that if the positions assumed by Morrell and Biscoe for their respective vessels are true, then Biscoe must have sailed over a portion of what was subsequently designated Enderby Land (Enderby Island). The deceptive forms of ice have by nearly all polar navigators been at one time or another taken for rising land surface, a condition which makes doubtful the references to many of the "land" masses that have been made known to us. It is by no means unreasonable to assume, with Petermann, that Antarctica may yet prove to be a disjointed association of land and ice masses, purely archipelagic in form; in this sense, Victoria Land, which is to-day the most extensive tract known, may be merely a correspondent of the insular form of New Zealand.

The only important addition to our knowledge of true Antarctica that has been made since Ross's voyage belongs to the close of the year 1893, when Larsen penetrated, in the region of the Graham Land complex, to latitude 68° 10′ south, and brought back with him a "departure" in the geological concept of the region under consideration. The finding of Tertiary fossils (*Cytherea, Natica,* etc.) on Seymour Island (Cape Seymour) is the opening vista in an investigation which has heretofore been considered closed, and at once affords, to use a business term, a basis for consideration. Not less significant is the finding at the same locality of an abundance of tree remains (conifers, *Araucaria* ?). These fragments at least show that some part of Antarctica was of the same kind of construction as the continents generally, and their special *facies* immediately suggests a South American relationship. Previous to 1893 the only rocks known from the ice-bound region of the far south were granites, gneisses, (and related schists), the strictly eruptive and trappean rocks, and certain red sandstones (Piner's Island—Triassic ?) from a very limited area. Most (and perhaps nearly all) of the higher mountains are distinctly of a volcanic nature, and many of them bear huge craters on their summits. Ross found Erebus in eruption at the time of his visit (1841), and Larsen found the mountains of Christensen and Lindenberg Islands similarly active in 1893–'94. Kristensen and Borchgrevink, who sailed over a portion of Ross's

course in 1894–'95, attaining off Victoria Land, with clear water ahead of them, latitude 74° south, confirm in almost every detail the observations of their predecessor, adding some additional facts regarding the large glaciers which descend from the heights of the Sabine Mountains. They were the first to set foot on the mainland (or main island) of Antarctica, and to them science also owes the first discovery within this realm of a rock-covering vegetation (lichens ?—on Possession Island and Cape Adare).

In its relation to other continents there is reason to believe that Antarctica, whether as a continent or in fragmented parts, had a definite connection with one or more of the land masses lying to the north, and the suspicion can hardly be avoided that such connection was, if with nothing else, with at least New Zealand (and through it with Australia) and Patagonia. In the fragmented parts of Graham Land archipelago and the outlying South Orkney and South Georgian Islands, we seem to have the bond of connection with the South American main; or, more specifically, a line of curvature of the great Andean chain, which, in its broken parts, can still be traced far beyond its present continental termination. If this concept is a true one, it places before us a parallel to the Andean curvature in the northern part of the South American continent, where the mountain system is deflected off into the broken mass of the Lesser Antilles; to the Aleutian flexure of the Cordilleran system of North America; and to the "Apennine-Atlas" and "Carpathian-Balkan" flexures of the Alpine mountains, the nature of which has been so clearly stated by Suess. In fact, it is hardly possible that any very extensive meridional or latitudinal mountain chain could have been forced up through contractional force without some such deflection being represented in one or more parts of its course; and where these deflections are found they are almost certain to be areas of breakage. The disruption of the Andean system is still (or has until recently been) taking place, as is evidenced in a portion of the Chilian archipelago.

When we look for the evidence of connection such as has been indicated, we find it in the fossils of Cape Seymour, already referred to, in a part of the living fauna of the continents of the southern hemisphere, and in the vestiges of a past life which these continents reveal. Thus, among land animals whose history favors this view, are the South American ostriches, whose close and only immediate allies are the ostriches and other large ratite birds of the African and Australian regions. The union of these birds in the southern continents, whatever may have been the exact place of their origination, gives evidence of migration, and this migration in the case of non-flying birds could only have taken place along united land areas. It may be assumed, and has

been assumed, that these large and seemingly closely related birds may have been independently developed in the regions which they now occupy; but in view of certain facts presented by other groups of animals, especially the quadrupeds, it is probably safer to assume that their origin was a common one, and that they were distributed over a land surface which had union with South America, Africa, and Australia, or New Zealand. Such a uniting land mass was not improbably ancient Antarctica.

Much more positive evidence bearing upon the question under consideration is afforded by the composition of the South American Tertiary mammalian fauna. Up to and inclusive of the Miocene period this fauna was a distinctively South American one, or at least not North American. The hoofed animals representing various orders (*Toxodontia*, etc.) were of a type at that time almost unknown in the north; there were no true artiodactyls or perissodactyls, and no insectivores, cheiropters, creodonts, or carnivores. The essentials of the fauna were recruited from the orders of edentates, marsupials, and rodents; the first named have specifically South American types, as the sloths and armadillos, while the last named, also specifically South American, lacked the more common northern forms, such as the hares, rats, squirrels, marmots, and beavers. The middle Tertiary fauna thus gives evidence of the isolation of this portion of the continental tract, and leans to the probability that the fauna then and there existing was derived from a southern source. It is only in the later or Pliocene period that we have an introduction of the northern types of quadrupeds, such as the true carnivores, deer, horses, mastodons, etc. Whether or not the region where this southern South American fauna originated was the region of South America itself, or another land mass that was at one time united with it, is not made clear by the evidence of the faunal elements that have been noted; but significant in this connection, as has been pointed out by Prof. W. B. Scott, is the relationship of the Miocene marsupials, which incorporate within themselves a number of distinctively Australian types, a condition that has been properly emphasized by the investigator last mentioned as giving strong evidence of a former union between the two main southern continents.

In explanation of the anomaly, assuming a connection between South America and Australia, that none of the South American mammalian types reached Australia, Prof. Scott suggests an early connection between the latter region and Antarctica (and through it with South America, thus permitting of a broad dispersion of the marsupialian types), and then a final severance before the appearance of the placental form of quadrupeds. Whether this explanation will ultimately prove to be the correct one or not,

the geological construction of the region makes it very probable that a disruption of the Austral tract took place before that of the South American.

Prof. Scott, in a review of the relationship of the southern land masses (Science, February 28, 1896), thus states his position: "In conclusion, it may be observed that the facts of paleontology may best be explained on the assumption that the antarctic land mass has at one time or another been connected with Africa, Australia, and South America, which formerly radiated from the south pole as North America and Eurasia now do from the north pole. While this seems a highly probable assumption, much remains to be done before the history of the southern continents is as well known as that of the northern ones, and in particular many questions must remain open until the Tertiary mammals of Africa and Australia shall have been recovered."

This evidence from paleontology may thus be taken to strongly supplement that which comes from the side of pure geology—evidence indicating a much further extension southward of the South American continent, and of a former union between it and a past and still partially existing Antarctica.

CONSUMPTION AND CONSUMPTIVES.

By WILLIAM L. RUSSELL, M. D.

TEN or twelve years ago even the most advanced physicians were not agreed that consumption belonged to the communicable diseases, and practically none took any steps to prevent its spread from the sick to the well. In fact, there were not a few who denied that it was ever contracted in this way. Heredity, physical conformation, atmospheric and soil conditions were regarded as the important factors, and all efforts were directed to the study and control of these. To-day there is an entire change of position. Communicability stands first in importance, and there are few who deny that it is the essential factor in the perpetuation of the disease. The most strenuous efforts now being made against its ravages are based on the belief that the greatest menace to the well is the presence of the sick.

Tuberculosis—of which, as will be explained more fully below, consumption is a variety—now appears at the head of the list of contagious diseases published weekly by the New York Board of Health, and means have been taken to have all cases in the city reported and instructed. Circulars containing directions for preventing contagion by disinfection of sputa have been placed in the hands of physicians for distribution, and many, if not all,

reported cases are visited and instructed by the health officers. When an apartment has been vacated by a consumptive the following notice is posted:

NOTICE.

Consumption is a communicable disease. This apartment has been occupied by a consumptive, and may have thus become infected. It must not be occupied by persons other than those residing here until an order from the Board of Health, directing that it be cleaned and renovated, has been complied with.

Name of occupant.....

Floor..... No..... St.....

This notice must not be removed until the order of the Board of Health has been complied with.

The directions for cleaning and renovating require that calcimined or whitewashed walls and ceilings be washed with a solution of washing soda (one half pound to three gallons of water), and then calcimined or whitewashed afresh; that papered walls and ceilings be washed with the same solution and repapered; and that the woodwork be similarly washed and then repainted. Cleansing and renovating are aimed at rather than disinfection. These measures can be taken as an example of the method of dealing with tubercular lung disease in every large city, and, in fact, throughout nearly the whole country.

The reason for this new departure is to be found in the rounding out of the evidence of the contagious nature of consumption, by the discovery of the living agent whose presence and growth constitute the very essence of the disease, and the transfer of which from the sick to the well causes its spread. This is the microscopic, rod-shaped, vegetable organism named the tubercle bacillus. It was discovered by Dr. Koch, of Berlin, in 1882, and much of the mystery which had previously shrouded the disease was thereupon cleared up; for, although consumption is a disease which has been recognized during the whole period covered by history, no adequate explanation of its nature was offered until recent times. Previous to this century, it was thought that the destruction of the lungs was due to simple inflammation and ulceration. Then Laennec, a French physician, who invented the stethoscope, set forth the view that the small, pearl-like bodies with which the lungs were found studded constituted the sole cause. He called these bodies tubercles, and thus the disease came to be spoken of as tuberculosis.

Laennec's view was not accepted without opposition, and, until Koch's discovery set the matter at rest, many claimed that there were two or more kinds of consumption. In 1867, Villemin, also a Frenchman, demonstrated the possibility of producing the disease in certain animals by inoculating them with tuberculous

material. It was found by others, however, that the same animals became tubercular if inoculated with apparently innocent material, or simply if an open sore were kept on them. The matter was thus still unsettled. The pathologists now came to the support of the contagionists by the discovery that the development and extension of the disease in contiguous cells and tissues and along the small vessels could only be explained by the presence of a contagious element. When, therefore, Koch demonstrated that the tubercles themselves were but the work of living organisms which had been introduced from without, a flood of light was thrown on the subject which cleared up all disputed points. He showed that not only was the diseased tissue crowded with these organisms, but that they were being constantly discharged in the sputum; that they could be cultivated in colonies free from all other germs outside the body; and that the pure cultures introduced into healthy animals caused them to become diseased, the bacilli being again found in their dead bodies. It may then be accepted as a settled fact that consumption is invariably produced by the introduction into the lungs from without the body of vegetable organisms, which, finding lodgment, multiply and eventually cause the destructive changes by which the death of the individual is accomplished. When it is remembered that consumptives have been expectorating countless millions of these organisms for ages, and that the cattle whose milk and flesh are used for food are not exempt from tuberculosis, no mystery need surround the source of any particular case. The mystery is rather that any of us escape. Nor could we, were it not that certain conditions, happily not always fulfilled, are necessary before the germs gain a foothold in the body.

It may strike some as extraordinary that while the contagiousness of the fevers, of cholera, and syphilis was established beyond question before disease germs were discovered, sufficiently convincing evidence was not also at hand in the case of such a prevalent disease as consumption. The popular conception of contagion and contagious disease has been derived from the behavior of such a disease as smallpox. It prevails often as an epidemic. Its onset is sudden and accompanied by pronounced symptoms. It runs a short and sharp course, and results in speedy death or recovery. A large proportion of those exposed are attacked, and the exposure may have been very brief. The case is entirely different with tuberculosis. Epidemics are almost unknown. The beginning of the disease is usually obscure and insidious; the course may extend over months and even many years, the individual being perhaps not seemingly very ill during much of the time. The majority of those exposed seem to have escaped, and of those attacked comparatively few are known to have been in

especially close relations with the sick. It will thus be seen that in the one case the evidence is nearly always clear, cumulative, and convincing, in the other it is usually confusing and sometimes contradictory. In former times, when controversies on the subject were frequent in the medical profession, equally good observers often came to diametrically opposite conclusions. It must not be supposed, however, that knowledge of the bacillus as a causative agent is the only ground for belief in the contagiousness of consumption. If this were the case, the matter could hardly be regarded as settled, for malarial fevers are known to be produced by a micro-organism, but are not contagious. There has seldom or never been a time when a conviction that consumption was contagious did not prevail to some extent, and few physicians of much experience have failed to see one or more cases which could only be satisfactorily accounted for on this ground. It has even occasionally happened that in certain localities this theory of its nature has gained such widespread credence as to lead to definite action. This was the case in Italy during the period from 1787 to 1848, when vigorous measures were taken to stamp out the disease, and a special hospital for consumptives was established at Olivuzza. At Naples the bedding of consumptives was burned, and their vacated apartments were completely renovated before being used again. In fact, the unfortunate sufferers were often shunned, and whole families were driven to want. It is said, however, that this method of dealing with the disease made no impression on the death-rate, and it was therefore abandoned.

Some of the recorded instances of the communicability of tuberculosis are, especially with our added knowledge of the bacillus, quite striking. Among these may be mentioned the inoculation experiments of Villemin, already referred to. Before this, however, Laennec, who became eventually a victim to the disease, believed that he had inoculated his own finger by means of a saw while he was making a post-mor em examination of the dead body of a consumptive. A tuberculous nodule developed at the seat of the wound. Morgagni, too, at a still earlier period, showed by his writings that he realized the danger of inoculation in this way. Calves which have sucked cows suffering from pearl disease or tuberculosis are frequently found to be affected with the same disease. Dr. Jacobi has recorded an instance of a dog contracting tuberculosis by licking the sputa of his diseased master as he followed him about the garden. Acute or hasty consumption has prevailed in almost epidemic form among young recruits in crowded barracks in England, and the inmates of certain convents have been almost exterminated by the same disease. In a convent in Louisville nine of the nuns developed consumption

within four months of the introduction of the first case, and four of them died. No new cases occurred after the remaining sick had been removed. In 1787 an inmate of a convent in Bilbao, Spain, died of consumption, and, as was customary then, the bedding and furniture were destroyed and the room thoroughly cleaned before it was again occupied. Two months later the new occupant of the room was attacked by the disease and afterward died. The same cleaning and destruction of furniture followed, but the next occupant succumbed within a year. It was then discovered that certain cords which might have been the means of conveying the disease had been allowed to remain in the room. These were now removed, the same precautions taken as before, and no other case had appeared at the end of five years. A few years ago the British Medical Association made an attempt to investigate the subject, and a circular letter of inquiry concerning cases of contraction by contagion was sent to each member. Reports of three hundred and twenty-one instances were received, two hundred and twenty-three of which related to husbands or wives who were thought to have contracted the disease the one from the other. It is worthy of note that many observers of long experience had seen but one or two instances, and some had not seen any.

The following observations relate to instances in which there have been more than one husband or wife, and embrace all such that have been recorded:

1. Thirteen instances in which a consumptive man had married more than one healthy wife. There were in all thirty-one wives, of whom twenty-seven contracted the disease, four remaining perfectly well.

2. Three instances of a wife becoming infected from her husband, and a second husband from her.

3. Two instances of women dying of consumption, after each had lost two husbands by the same disease.

4. Ten instances of husbands contracting the disease from their first wives, and their second wives in turn from them.

5. One instance in which a man had become infected from a diseased wife, his second wife from him, and a second husband from her.

The marriage relation furnishes conditions exceptionally favorable to contagion, and it is not surprising that so many of the recorded instances relate to contraction of the disease from husband or wife. And yet it can hardly be claimed that most of those who lose husband or wife by consumption contract the disease. Of 6,167 patients who had been treated at the Brompton Hospital in 1863, but 239 were widowed. Of these, however, 106 had lost husband or wife by consumption. Dr. Cotton, of Eng-

land, found that only eleven of one thousand cases which he investigated had lost husband or wife by the disease, and our own Dr. Flint states that there were but five such instances in 670 cases observed by him.

Previous to the discovery of the bacillus, such observations as those last mentioned led many to doubt that consumption was communicable at all. It may be well, then, to consider a few other facts pointing to the same conclusion, as they are important in arriving at correct views on the whole matter. Chief among them may be mentioned the experience of the Brompton and Victoria Park Hospitals of London, where consumptives have been treated for many years. It is well to recall at the same time that special precautions against contagion have not been taken until recently. It was stated in 1882 that of sixty or seventy physicians employed at these hospitals during twenty years, but five had been attacked by consumption, of whom two died. The record of the large number of nurses employed during the same period, and whose relations with the sick were more intimate than those of the doctors, was still better; there were but two cases, and one of these was doubtful. One of the physicians to these hospitals, Dr. Williams, says that though he has been watching for twenty years he has not yet met with a case in which alleged contagion could be sustained, after close investigation. He adds that while the disease may be contracted in this way, the circumstances must be extremely favorable. At the Vienna General Hospital, where 2,736 deaths from consumption occurred in three years, not a physician or nurse was known to have contracted the disease. Nearly every one has known of relatives or friends who have lived in the most intimate relations with consumptives for long periods and have suffered no injury whatever.

Now, it does not follow from these observations that we are mistaken in assuming that consumption is communicable. We shall see in a moment that there is a good reason for exceptional instances. It is quite possible, though, that in our enthusiastic zeal to deal with it and stamp it out on this basis other important considerations are being neglected. Destruction of clothing and renovation of rooms seem to have been pretty thoroughly practiced in Naples and other places a hundred years ago without making any impression on the death-rate. Improvements in general sanitary conditions at Naples, however, have in these later times had a marked effect. It is, to be sure, highly important to destroy or disinfect sputa, and to discourage in general the pernicious practice of expectorating. The sputum is the very fountain-head from which the army of bacilli is re-enforced. This does not necessarily imply, however, that the concentration of our

efforts on the destruction of the bacilli is the only, or even the best, way of exterminating the disease. Few diseases prevail so generally throughout the world as tuberculosis. No zone is exempt from its ravages, and it has prevailed from the earliest times. Its victims constitute seventeen per cent of all deaths, and nearly five thousand succumbed to it in New York city in 1894. It affects also the lower animals, especially the cow, which is so important a source of food supply. Many persons are fatally affected by it long before they are obliged to leave their occupations, or even to consult a physician. The methods which have proved so successful with the acute infectious diseases can hardly be applied effectually with such a disease as this, and the attempt to deal with it solely on this line may even prove mischievous sometimes by fostering a belief that exemption can be secured simply by shunning the sick. Should such a view prevail generally, unnecessarily severe and even cruel measures would sometimes be adopted by the timid and ignorant. Not long ago a writer proposed that all cases be segregated and quarantined in a valley in New Mexico, where climatic conditions were favorable to recovery, Government aid being given the impecunious, and a leading New York daily commented favorably on the proposition.

The importance, then, of correct views on this subject can scarcely be overestimated. We have seen that, though the disease is undoubtedly communicable, it does not prove so under all circumstances. It is a question if any one of sound heredity and good health has ever developed it simply from living with a consumptive in ordinarily good hygienic surroundings. It is generally admitted that predisposing conditions can always be found. The germs of this disease can not obtain a foothold until the resistive powers of the tissues have been reduced. There must be not only the seed but the soil. This impaired power of resistance may be the result of heredity, and this influence in the causation of disease is seldom shown to better advantage than in the history of consumption. There have been instances in which a single case introduced into a long and sound ancestry has vitiated the stock forever. How unfortunate that such matters are so little considered in marrying and giving in marriage! It is not that the disease is inherited, but the vulnerable tissues, the feeble resistive powers, render the offspring an easy prey to the ubiquitous bacillus. This weakness often shows itself by a tendency to become ill from slight causes, a sickliness, not by any means to be confounded with merely a lack of robustness or strength. One organ or part of the body, frequently the mucous membrane, is usually more prone to become affected, and the beginning of the disease can often be traced to an attack of some slight ailment. Not only the children of consumptive parents

may show these characteristics, but also those of parents generally enfeebled, or whose ages are widely separated, or who are closely related by blood, or of a mother who has previously borne a number in quick succession. Even when heredity is sound, the same condition is sometimes induced by coddling, by improper feeding, by attacks of acute disease, or by want and distress. In growing children, a bad carriage of body may act injuriously by contracting and deforming the chest. The stooped position which boys sometimes assume in bicycle-riding should be discouraged for this reason.

Before the period of bacteriological research conditions thought to bear a causative relation to consumption were eagerly studied. Some of these thought to be important, it can now be seen, were principally operative by affording favorable circumstances for contagion, or were themselves symptoms of disease already present. They still teach useful lessons, however, and deserve more attention than is at present given them. We all know now the reason why bad air was for so long regarded as a cause of the disease, but it still remains the fact, nevertheless. Imperfect food supply was also assigned a place among the causes, but second to an imperfect supply of pure air. Well-fed factory operatives who work in close rooms are much more prone to the disease than poorly fed laborers who work outdoors. A French laborer moved to Paris with his wife and three sons from the country, where they had worked outdoors. The father and two of the sons soon died of tuberculosis; the mother and remaining son returned to the country and survived. This illustrates the well-known fact that the mortality increases with the density of population, being greatest in large cities and in barracks, prisons, and factories. Sixty-seven per cent of the deaths among the Guards in the English army are due to it. The death-rate in prisons increases steadily with the years of confinement, and diminishes as ventilation is improved. Inadequate nutrition because of insufficient food supply or of indigestion, which in turn may be the result of improper or poorly prepared food, undoubtedly predisposes to the disease. The same may be said of exhausting discharges or hæmorrhages, of childbearing, of enervating habits or practices, and of depressing emotions, all of which tend to reduce the resistive power of the body. Considerable importance has been attached to damp soil, and it would seem justly so. Dr. Buchanan, of England, found that the drainage of such soil always reduced the death-rate among the inhabitants of the region. Dr. Bowditch, of Boston, says that three fourths of 201 cases investigated by him lived in houses built on damp soil. He observed also that the death-rate was lowered by draining. He mentions several specific instances, among them the following: A and B married sisters.

No tuberculosis had ever been known in any of the families, except perhaps in the case of one grandmother, who had marks of former abscesses in her neck. A and his wife lived on dry soil. They had nine children, all of whom remained healthy. The house of B, on the other hand, was on damp soil. His wife and six of his eleven children died of consumption, and one of the survivors was ill with the disease when the observations were made.

The importance of these predisposing conditions can only be realized by knowing that the large majority of consumptives have never lived with others similarly affected. The disease is in these cases a result of a combination of circumstances into which direct known exposure has not entered. Nor can immunity be secured by shunning the sick. In fact, nothing further is required to protect those of sound health and heredity, who are obliged to associate with consumptives, than scrupulous cleanliness and an abundant supply of fresh air and sunshine. If, in addition, the sputum and everything soiled by it are destroyed and disinfected, the sick become harmless to all. The human body has within it the capacity of preventing the lodgment and growth of the tubercle bacillus. This capacity is only overcome as a result of hereditary or acquired influences. It is against these that the efforts of every one can and ought to be directed.

DISINFECTION AT QUARANTINE.

A FLOATING DISINFECTING PLANT.

By M. E. WARD.

THE necessity of thorough precautionary quarantine methods is generally accepted. The adoption and adaptation of methods and apparatus to keep pace with the knowledge that scientific research has placed at command is a matter that directly concerns the public and the departments of public health. That ceaseless watchfulness should be maintained, that trained diligence combined with high scientific skill should be a means to attain efficiency, that appliances in use should combine simplicity with efficiency, that in their operation delay of all kinds should be avoided, and that the individual should receive consideration and every comfort and convenience enlightened civilization can provide, are axiomatic facts.

Our great seaports and ports of entry are the centers most exposed to contagion and infection. Disease germs from the civilized and uncivilized parts of the world tend to drift there, carried by an ever-moving stream of emigration and traffic. The larger the center, the greater the number that pass through it to

gain access to other parts of the country, carrying with them whatever of good or ill they may bring. Their baggage and clothing, if from infected ports, can carry the seeds of disease and afford favorable conditions for the reproduction of germ life.

The port of New York, with its magnificent harbor and immense marine commerce, is one of the centers that requires intense, concentrated vigilance to protect the city itself and the country at large. One of its great dangers is that of disease brought by incoming vessels.

The health officer of the port of New York has charge of the health of all of those on incoming vessels. The headquarters of the boarding station is situated at the Narrows, on the Staten Island shore. Side by side are the grim fort and the health officer's headquarters—the one an arm of the nation, the other a department of the State; both there to guard and protect the safety of the country. Detention at quarantine has been a precautionary measure, the disinfecting process slow and laborious.

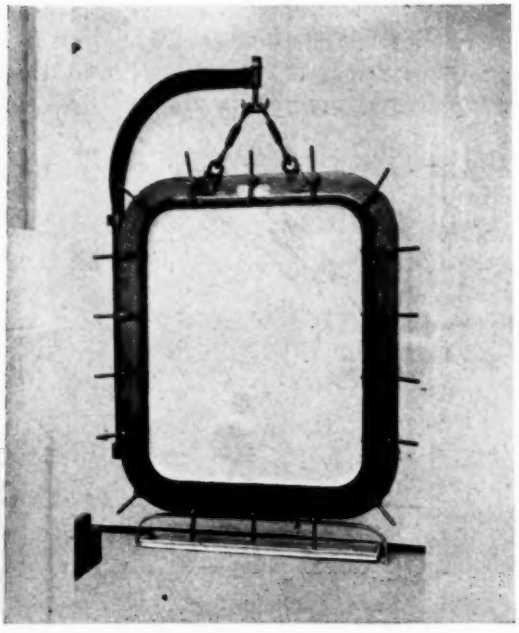
HOT AND COLD WATER SUPPLY COCKS.

Disinfection is the destruction of germ life. The penetrative quality of the means is a most important factor. Access to the seeds of disease, destruction of germ life, and the removal of conditions favorable to the reproduction of germ life are necessary to effect thorough disinfection. The destruction of the germ to be effected without the destruction of property or unnecessary inconvenience or delay is the problem.

The means in use consists of a steam disinfecting chamber (two hundred and thirty degrees of heat is destructive to germ life); bichloride of mercury used in solution of 1 to 1,000 or 1 to 1,200; sulphur fumes, which last have but little penetrative quality; and sea-water and salt-water soap for bathing purposes, to be used when necessary. It has been found expedient to combine these means and construct apparatus to enable the process of disinfection to be carried out rapidly and thoroughly.

The floating disinfecting plant system now contains all that is needed to effect a thorough and complete disinfection. The people detained are submitted to a rapid and efficacious process of cleansing and disinfection, their clothing being treated simul-

taneously, and their privacy considered even when under strict supervision. The officers in charge can direct and control all operations from the central part of the vessel, and, being provided with separate toilet and disinfecting facilities, can return to their quarters or gain access to any part of the vessel without danger of conveying infection and without delay. Fitted with the combined apparatus, a boat containing the plant can be run alongside the suspected vessel, which can then be thoroughly cleansed, disinfected, and fumigated, the passengers and crew bathed, their clothing subjected to steam sterilization, and returned to them uninjured, and all baggage and bedding treated to a complete disinfection. The crew and attendants have their comfort and health cared for separately.



DOOR OF DISINFECTING CHAMBER CLOSED.

Under the direction of A. H. Doty, M. D., health officer of the port of New York, the old side-wheeler Ripple has been remodeled. She looks new from end to end, and under the name of James W. Wadsworth presents a very trim, businesslike appearance. Inside she is arranged to economize every available inch of space, and is finished in such a manner that no germs of disease can be left to lurk undestroyed.

The Wadsworth has a twofold duty to perform: the bathing and disinfection of passengers, crew, and baggage; and the cleansing, disinfection, and fumigation of their vessel.

The passengers and crew and their effects are transferred to the disinfecting boat for treatment, and their vessel is thoroughly disinfected before they are permitted to return to it.

To effect this work with rapidity, there are several separate processes, each with its own set of apparatus, conveniently located. Each or all can be operated from the central part of the vessel, where the officer in charge of the disinfecting processes is stationed.

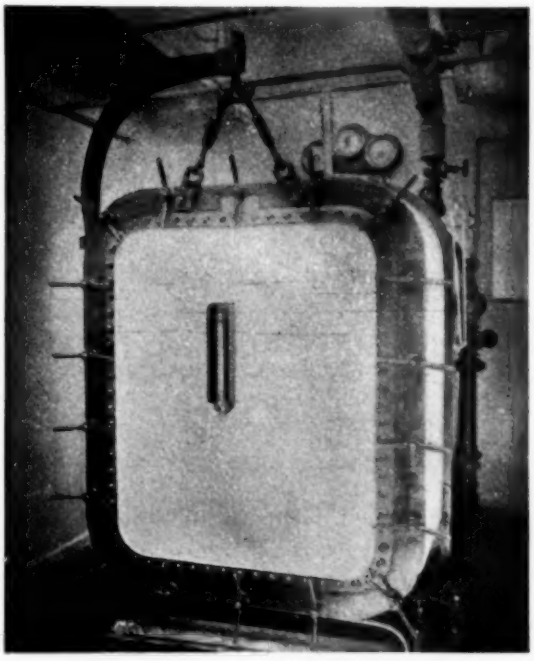
The plant contains a disinfecting chamber; bichloride tanks, with separate pumps and hose system; soda tank and hose system; salt-water pump and connections for the baths; sulphur furnace with air pumps and reservoir; and a central office, containing indicators and the controlling apparatus of the entire disinfecting system.

The boat is fitted with two immense fresh-water tanks; and the officer in charge can supply the baths with hot or cold, fresh or salt water at his discretion.

Outside, huge pipes, extra tanks to contain solutions, and conveniently situated cocks are visible. The railings have all been rearranged, to facilitate the handling of passengers.

The boat is practically divided into three sections: the after part of the vessel, which is devoted to the care, disinfection, and handling of passengers; forward, the crew's quarters; and the central part of the vessel, containing the boiler, engines, pumps, and furnaces, and the room where the operations are controlled, and a separate set of disinfecting and toilet apparatus for the use of the officers in charge.

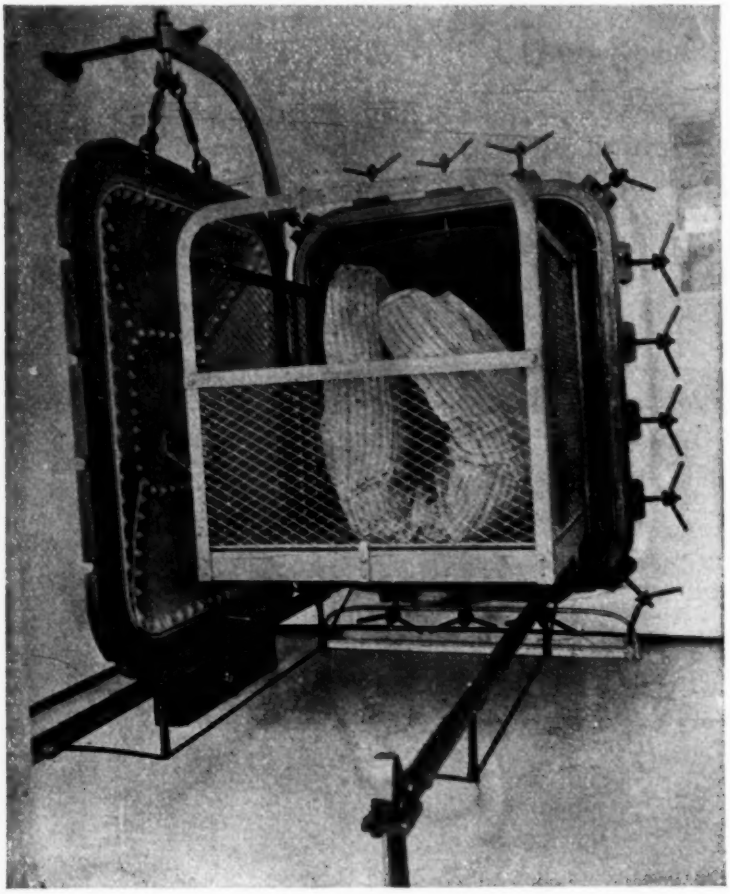
The disinfecting chamber is situated in the center of the after part of the vessel. Surrounding it are the reception rooms, disrobing rooms, bath rooms, and dressing rooms.



Discharging End of Disinfecting Chamber.

In a process of this kind it is necessary to take every precaution against the spreading of disease. This is provided for in the finish of the boat, which offers no resting place for disease germs to accumulate. All parts of the boat where the disinfecting processes take place are lined with sheet iron, finished with white enamel. The floors are of sheet lead, each furnished with a separate outlet pipe. Each room has a separate floor, which does not directly communicate with adjoining rooms; and the lead floors are protected with

rubber mats, which can be treated without injury to a washing down with bichloride solution. The benches and other fixed furniture are set away from the walls to facilitate cleansing, and,



CAR RECEIVING PACKAGES BEFORE BEING RUN INTO DISINFECTING CHAMBER.

together with their fittings, are finished in white enamel, affording free surfaces, readily cleansed and disinfected.

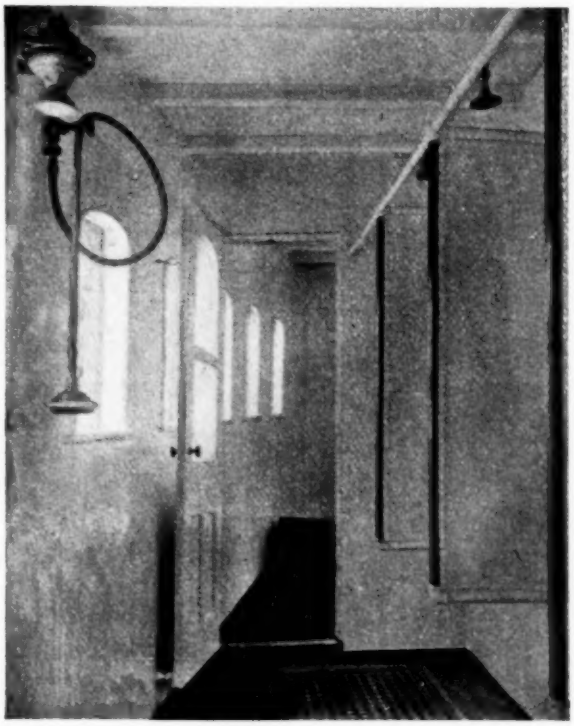
The two bath rooms—an illustration of one of which is shown—are provided with showers and extra flexible hose connection for hosing down. The baths and the temperature of the water used are regulated in the central office; and the hot and cold levers are so arranged that the cold water always precedes the hot, thus preventing a sudden or too great rise of temperature in the flow of water when distributed by the showers.

The passengers are assembled for disinfection aft, on the upper deck. From there they descend to the reception room, which is situated over the stern. Opening from the reception room, on

either hand, are the entrances to the disrobing rooms. Entering one of these, the passenger to be disinfected removes all clothing, which is then made into a bundle, checked, and tossed through a convenient opening into the receiving car of the disinfecting chamber. The passenger proceeds through a door opposite to the one by which he entered to the bath room; from there again, through another exit, to the dressing room, where the bundle of clothing awaits him, disinfected.

Thoroughly cleansed and disinfected, the passenger emerges clothed to proceed to the upper deck, to which there is a convenient staircase situated outside the dressing-room door. In a separate railed portion of the upper deck the passengers collect, and from there are returned to their vessel.

The entrance to the room into which the receiving end of the

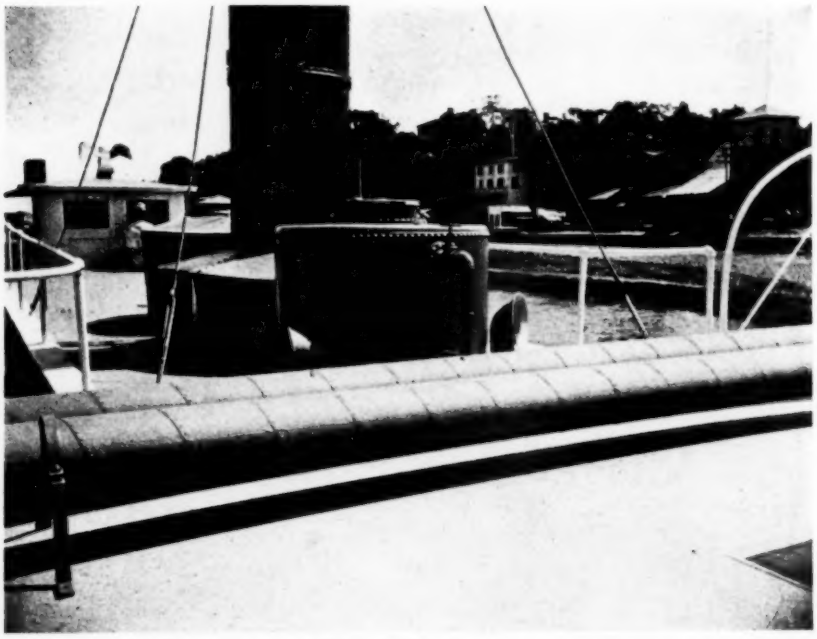


ONE OF THE BATH ROOMS.

disinfecting chamber opens is between the entrances to the two disrobing rooms.

The room into which the receiving end of the disinfecting chamber opens is finished in iron, enamel, and lead, as are all the other rooms. Overhead is a hatch in the upper deck, through which such large bundles as bedding, etc., can be lowered into the

receiving car. The car of the disinfecting chamber is run out or into this room on rails. These rails are movable, and can be taken up and replaced at will. In operating the disinfecting chamber these rails are placed in position, the door of the disinfecting chamber opened, and the car or crate run out. Into this car the bundles of clothing are tossed from the disrobing rooms, which



Bichloride Tank.

are situated on either side. From the deck above the bedding and other large objects to be disinfected are lowered into the car through the hatch. The car is then run into the disinfecting chamber, the door closed, and the process of disinfection commences. The door of the disinfecting chamber requires special mention. It is made of steel, protected by asbestos-magnesia covering, and is swung into place from a crane and secured by turnbuckles against a rubber gasket, effecting a perfect seal. The door is so hung that one man can handle and swing it even in a seaway, which is obviously a great advantage.

The disinfection of bedding, clothing, etc., is accomplished by means of steam sterilization. The penetrative quality of the means must be rendered effective.

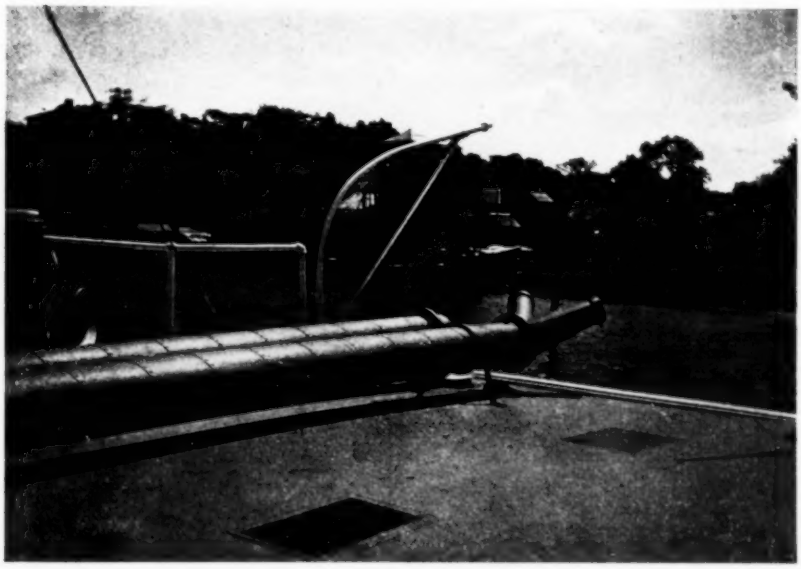
The disinfecting chamber is a huge steel room or chest, and in it the clothing, etc., are treated. A vacuum is created in the chamber and live steam introduced and exhausted until every part of the contents of the car has attained the desired degree of heat.

The bundles into which the clothing, etc., are rolled are securely fastened before being tossed into the receiving car, and remain there undisturbed, each numbered, to effect rapid identification.

The rapidity and thoroughness of this disinfection depend on the vacuum-system process.

The air is drawn from the disinfecting chamber, and as the vacuum increases the air is withdrawn from the interstices of the fabrics to be disinfected.

Advantage is now taken of the fact that a rise in the temperature takes place rapidly in a vacuum. To effect the rise in temperature, to attain the necessary degree of heat, live, dry, superheated steam is admitted to the interior of the disinfecting chamber. This steam contains in reality little more water than the air that was withdrawn, being in a finely divided state at the high temperature at which it is introduced into the vacuum. The



SULPHUR SUPPLY PIPES.

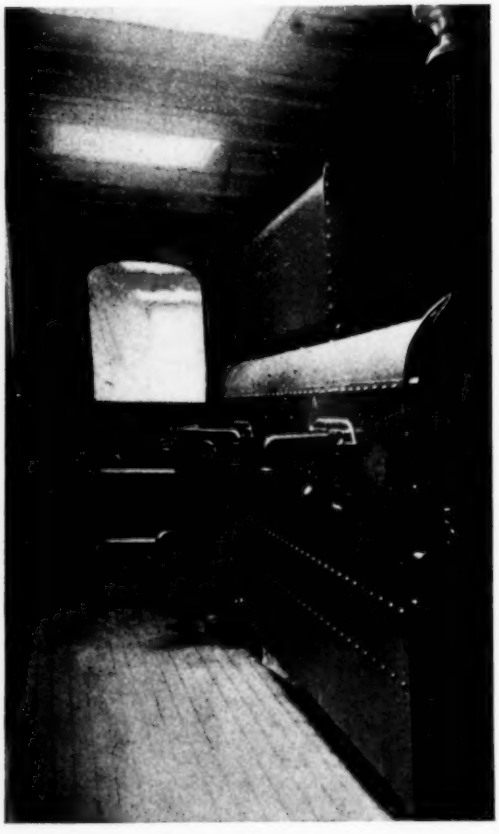
temperature is easily maintained, there being no air to convey away the heat; and the steam penetrates to every interstice of clothing or fabric.

After a proper temperature has been maintained for a sufficient length of time, cool air is admitted to the chamber and exhausted alternately, until the temperature is sufficiently lowered, when the clothing, etc., is removed and distributed.

The car is discharged at the opposite end of the chamber from which it entered. The huge steel chest of the disinfecting cham-

ber is double jacketed, and protected by asbestos-magnesia covering. The operations of the chamber are controlled by means of a Foster valve.

The interior of the disinfecting chamber has fixed rails for the car to run upon, and is also fitted with a shield to protect the contents of the car from damage by condensed moisture. All water formed on the roof of the chamber drops from the shield into a receiving pan, and can be drawn off from there by a separate connection. The clothing treated is not injured in any way.



SULPHUR FURNACE.

The discharging end of the car opens into the room where the health officer controls the disinfecting system. This end is fitted with a door similar to the one already described. In operating the chamber, one door is closed first, and steam admitted to the jacket, and as much air expelled by expansion as possible before the second door is closed. Then the air is exhausted and the vacuum process effects a thorough disinfection.

The vacuum is produced by the siphon process: steam under high pressure is driven across the end of a tube leading into the interior of the disinfecting chamber. This tube is fitted with valves and cocks. The jacket of the disinfecting chamber is fitted with separate valves and cocks, and the temperature can be raised, if desired, without admitting steam to the interior of the disinfecting chamber.

The Wadsworth has but one boiler, but that is large for the size of the boat. It supplies steam power to work the entire disinfecting system, as well as the power to run the boat's engines. The top of the dome of the boiler is fitted with a pipe leading to an extra dome; this is the reservoir that supplies the super-

heated steam for the disinfecting chamber. The engines supply power to all the different pumping systems in the vessel; and fitted as the Wadsworth is with such powerful and complete pumps and hose system, she can be used as a fire boat should occasion require.

There are pumps for hot water, for cold water, for sea water, for bichloride solution, and for soda solution. The salt-water pump is made of composite metal. Ball-nozzle hose are used.

The sulphur furnace has four pans, each large enough to contain a couple of pails of sulphur. The sulphur fumes are collected and retained in a tank above the furnace, and drawn off as needed by a rotary fan, to be distributed through a huge system of supply pipes. About four pounds of sulphur to one thousand feet of cubic space is used. After the sulphur dioxide is forced through the pipe system, the sulphur can be cut off and fresh air forced through the same pipe system.

In disinfecting a vessel the soda solution is used to remove grease and render accessible surfaces in constant use, which are then washed down with the bichloride solution, which is followed by a thorough rinsing of sea water.

The crew's quarters of the Wadsworth have a separate fresh-water tank and separate bathing and toilet facilities. Cedar is the wood used throughout the forecastle, which is finished so that whitewash can be readily applied. All parts of the vessel that carry the disinfectant plant are finished so that they can be thoroughly hosed down without danger of the waste being carried to the bilge. The ventilation is as nearly perfect as possible; all the rooms and quarters have plenty of light and air.

The clothing can be treated in a very few minutes, and the rest of the process is both rapid and efficacious. The boat is in commission, and the tests have all proved satisfactory.

Now that such progress has been made in the right direction, we shall expect to see our local health departments equipped with something similar, that is at once compact and capable of cleansing and disinfecting either a room or a district at short notice.

ONE of the oldest French almanacs, described by M. Gaston Tissandier in *La Nature*, is *Le Kalendrier des Bergiers*, or Shepherds' Calendar, printed at Lyons in 1504. It contains many curious things, among them a calendar of feast days, which are calculated by counting on the fingers and joints. This is followed by some astronomical information, and then by articles—most of them curiously illustrated—on the tree and branches of the vices, the pains of hell, the book of the salvation of the soul, the "nathomie" of the human body, the art of "fleubothomie" of the veins, the astrology of shepherds, the sayings of birds, the judgments of "phigonomie," how to know the planet under which a child is born, etc.

A STUDY IN RACE PSYCHOLOGY.

By ANNA TOLMAN SMITH.

THE average American negro presents a puzzling contradiction in his educational progress. As a rule he masters the elements of reading with ease; but as a rule also the developed language, the expressive medium of subtle relations and of complex experiences, defies his efforts. It is true that even the untutored roll off abstruse terms and involved phrases with peculiar unction, but this is a case of "words, words," that rather proves than disproves my meaning. I have in mind not sound as such, but sound as "an echo of sense."

The phenomenon which I have mentioned had so often been brought to my notice that I put myself at last to find out the explanation. This could only be done by examining a particular case. Circumstances determined the selection, with the result, of course, that there are conditions to be weighed in the balance. On the whole, however, the case, I believe, is typical. The subject of my experiment is very nearly a full negro, if family tradition and family features may be trusted. No trace of white blood is discernible in either parent, and their ancestors known to them for two generations back were negroes like themselves. On the father's side, tradition says, there was an Indian grandfather three removes from the present generation, but the Indian element has been lost in the transmittal, unless possibly it survives in a slight modification of the African hue. The man is of a dark coffee color, stout built, strong, sluggish, and extremely faithful, as is shown by the fact that he has retained the same place eighteen years. The mother is slightly darker in color than her husband, and of tall, supple figure; her mind is active, her movements are quick; she rules and guides her household by virtue of a superiority that all instinctively recognize. As a girl she was trained to domestic service by a painstaking mistress, while the father passed his youth as an ordinary field hand. Three prenatal conditions are typified in the name which these parents with due ceremony bestowed upon their son—Isaiah Asbury Bell. The family name is theirs only by virtue of a previous condition of servitude to planter Bell; Methodism accounts for the second name, and pious reverence for a book which neither of them can read, and perhaps a certain pleasure in euphonious sounds, for the first. The latter inference is confirmed by the names given their three daughters—Triphenie, Romana, and Albertina. This sensitiveness to sound I note as a family trait, because it may prove to have some bearing upon the boy's personal equation. Isaiah is a young edition of his father, equally sluggish, awkward, and obsti-

nate. At the time of my experiments he was sixteen years old, and had been regularly at school since his tenth year—that is, for five years—and irregularly from his seventh to his tenth inclusive. He could read the Third Reader in a monotonous, stumbling way, perform simple operations in arithmetic quite rapidly, and write an excellent hand. As he was in my service, I thought it my duty to keep up his education, and, undismayed by many futile efforts with his predecessors in the place, I began daily reading exercises with him. Of necessity, the Third Reader does not interest a boy of sixteen, and, interest being the essential spur to acquisition, I tried the newspaper. Every day I selected some local occurrence which excited his mind, and by talking it over with him and explaining the new words endeavored to give him the mastery of the printed account. By this means the limitations of his vocabulary were soon apparent. It stopped with the names of familiar objects or of actions possible to himself. Outside of that range he never caught at new words as white children do, nor did they excite his curiosity even when the context was interesting. To illustrate: Here is a short list of words, no one of which conveyed any meaning to his mind—testify, drought, witness, apparent, fulfill. These all occurred in an account of the Knox fire, a local event which excited him greatly. We read the matter several times in slightly different forms, and I dwelt upon each of the strange words, giving familiar illustrations of their uses, but the very interest that he felt in the event about which we were reading seemed to interfere with his grasping these particulars. I think his mind never got beyond the general impression that the fire and the ruin as he saw it were described in the paper. His mental state, as it was revealed to me through his reading, might be described as unanalyzed content. Eager to get the true measure of his verbal power, I applied the familiar test of instantaneous associations with a given list of words. I submit the best results that I obtained after repeated experiments with varied lists:

CONCRETE TERMS.

Words.	*Associated Ideas.*	*Words.*	*Associated Ideas.*
Pole	North.	Vase	Blue.
Book	Black.	Hat	White.
Pencil	Lead.	Horse	Brown.
Paper	Reading.	Bear	Grizzly.
Fire	Place.	Procession	Street.

I had great difficulty in finding abstract terms which excited any response, but finally secured the following:

Words.	*Associated Ideas.*	*Words.*	*Associated Ideas.*
Strength	Man's.	Anger	John (the name of a comrade).
Memory	His.	Fear	Not.
Sorrow	His.	Disobedience.	
Time	Piece.	Love	He.
Courage	Dog.	Kindness.	

These experiments continued for some time. Meanwhile, vacation days having ended, Isaiah returned to school. Unfortunately, the boy had been kept grinding at the elements when flexibility and susceptibility had long passed their zenith. He had at last, however, arrived at the dignity of geography, which lent momentary zest to his flagging spirits. To encourage the new zeal, I talked over the subject with him at night. A lesson on the races of men seemed to impress him more than usual. When I asked him to repeat the five races whose names and traits he had learned in the morning; he recalled all but the Malay. I finally told him the forgotten name, when he instantly responded, "Oh, yes, the malaria race!" I repeated the name several times without comment, but he failed to notice the distinction. The very next evening a little white girl of ten years, who had also just entered the fifth grade, was telling me the same lesson, and she, like Isaiah, had forgotten the name of one race, the Mongolian. After the omission had been supplied, I turned to her mother and told the story of Isaiah's slip. Quick as a flash and with evident amusement the child exclaimed, "Oh, he mistook a disease for a people!" The inference is plain: the one had groups of apperceptions in her mind that were entirely wanting to the other.

That I may not fail to give the positive side of Isaiah's linguistic attainment, I present here a specimen of his original composition. It is an account of a feature in a well-known game which, so far as I can ascertain, was introduced by colored boys:

"The first boy who I new to play prisoners-base was Charles H. Dorsey And the way you play it is to have equal number on each side of the street and one has to show a lead if he get cought he has to hold out his hans, And if he falls he will say broken bones."

The statement, it will be seen, comprises fifty-five words besides a proper name. Of these, all but four are monosyllables. A peculiar phrasing not unlike that common among deaf-mutes has resulted from the boy's inability to master the subtleties of connecting particles.

The facts here presented are not, in themselves alone, either novel or significant. The question which they raise is, however, fundamental. Are they the sign of inherent deficiency or are they the outcome simply of external conditions? In dealing

with Isaiah I recognized that he had come rather late to the elements; this happens also with many white boys, and is by no means an insuperable obstacle to future progress. The circumstance really facilitated my study, as it gave me mental states more positive and well defined than those of younger children. Evidently the problem before me resolved itself into two conditions: the mind of the boy—his environment. The estimates of mind, reading, writing, etc., which formal education employs were evidently not applicable to this individual upon whom the school had left so slight an impress. While I was revolving the matter a new mode of testing his mental powers was suggested. I chanced one evening to be arranging some sets of small color cards in Isaiah's presence. It was evening, the light was dim, and I had difficulty in distinguishing the slightly different tints of the French blues and greens. Whenever I hesitated the boy, who was watching the work with undisguised interest, would instantly pick out the right card. As it was in a range of æsthetic tints which I was certain had had no part in his customary surroundings, I inferred that he had been through color exercises in school. Inquiry proved that I was mistaken; color perception and color distinction were natural powers improved simply by the observation of familiar things. Here too I discovered that a network of associations had arisen, the very condition whose absence had made advance in reading so difficult. His color associations were with natural objects, chiefly fruits and birds—for example, red with an apple, the inside of a melon, a robin's breast; blue with the sky and the jay, yellow with a lemon, and so on. Flowers he seldom mentioned. The reason is obvious. He had a gourmand's taste, and was already quite an experienced hunter. Associations ended with the primitive colors, his ready recognition of shades and hues being a mere matter of immediate perception.

A possible mode of applying the hint thus obtained was suggested by the memory tests described by Prof. Munsterberg in the Psychological Review for January, 1894. The material employed (i. e., colored squares, three and a half centimetres) was easily secured and was of precisely the kind to excite distinct perceptions in Isaiah's mind. Beyond the arrangement of the cards there was, however, no likeness between my experiments and those of Prof. Munsterberg alluded to. The series employed by me were shorter than his, consisting each of ten cards instead of twenty, arranged either for simultaneous or for successive presentation. My subject went through no preliminary training, and no time limit was set for his observation. He was at liberty to look at a series till he thought he knew it, when he proceeded to arrange a duplicate set of the cards in the same order from

memory. He had no idea of my purpose but regarded the exercise as a game, a notion which I encouraged by now and then pitting myself against him. Simple as the exercise appears, it afforded a clearer view of Isaiah's mind than speech could possibly have done. Here, at the stage of simple sensation and within the psychic circle that it evolves, he was all alert and responsive. It is difficult for me to convey a clear idea of his awakened activities; I can only sum up what he did in dry statistics, which are meaningless aside from comparison. I should add, with reference to the experiments, that in the absence of apparatus for signaling our expedient was as follows:

At the word *now* from Isaiah the series presented was covered and the duplicate set of cards placed before him. An assistant, watch in hand, marked the time passed both in examining and placing the cards. I did not caution Isaiah against the use of mnemonic devices, for I judged that he knew none, his range of associations being extremely limited. The experiments were made from twice to three times a week for about five weeks. In three instances, the same series was repeated twice in succession, in every other case a series was presented but once. The summary of results is as follows: Simultaneous presentation, eighteen series, ten colors each; average time for learning each color, five and three fourths seconds (or fifty-seven and a half seconds per series); average time for placing each color, nine and two thirds seconds, or one minute and thirty-six seconds per series; percentage of errors, 36·6. Successive presentations of ten series, ten colors each; average time for observing each color, five and three fifths seconds; average time for placing each color, nine and three fourths seconds; percentage of errors, twenty-nine.

I made occasional essays with aural series—i. e., reading the names of the colors arranged until Isaiah was ready to replace them. Of these I preserved only the following record: Four aural series, ten colors each; average time for learning each color, five and five sevenths seconds; average time for placing each color, six seconds; percentage of errors, fifty.

The experiments having proceeded thus far, I entered upon an educative series. By this means the time for learning a series was reduced to half a minute, and for placing the same, to forty-five seconds, while the percentage of errors fell to sixteen.

In arranging the series the boy's action was slow, and he seemed able to begin indiscrimately at either end or in the middle. Apparently he recalled the colors partly by name; this, however, helped him little, as he did not know the names of shades and neutral tints. I tried having him count, as a means of inhibiting the names when he was examining the cards, but I thought this helped rather than hindered, as the name attached

itself to the number that fell to it; in other words, here his mind instantly formed new associations. It would be absurd to compare the results of these experiments with those of Prof. Munsterberg already alluded to. The latter were performed upon adult subjects who were in training for the work, thoroughly possessed of its purposes, and supplied with instruments of precision for signaling, record, etc. Nevertheless, one can hardly fail to note that while the average time required by Isaiah for learning a series was from two to three times that allowed the trained students, his percentage of errors was on the whole less than their average. To realize exactly what the results indicate, one should try to see how many colors of a series he can replace after viewing them less than a minute.

I have given here a record of memory tests that were pursued systematically for a short time. Circumstances soon changed, and I was only able to make an occasional experiment with more complicated material; but one point was established to my satisfaction—namely, that Isaiah was endowed with the germs of mental life, perception, association, and memory. The question remained why these were not active in that most important of all school exercises—reading. The answer is to be found partly in the negroes' quick response to sense impressions. All persons familiar with their habits have noticed this susceptibility, but I believe Mr. R. Meade Bache is the first to bring it to proof in the laboratory.

The results of his experiments, presented in the Psychological Review of September, point very clearly to the conclusion that the negro race is superior to the white in automatic power. Here, I believe, we have the key to Isaiah's success in reproducing an impression received through the senses, and also, in general, to the ease with which children of his race go through the elementary process of learning to read. Speech is a power that comes to most of us unconsciously, and the first stages of reading require little more than the visual recognition of signs that stand for familiar things. But, this stage passed, every word is a generalization, back of which lie traditions, customs, experiences, sentiments, and ideas, which are the heritage of a race. They are the stuff of the mind transmitted from generation to generation through the myriad channels of family, of social, of school, of church, and of business life. It is obvious that to a race wanting in our own experiences a large part of our vocabulary must be meaningless. Analogous experiences, of course, give insight into a foreign tongue, but here the colored child is at a peculiar disadvantage. The traditions of African savagery, even if they had reached him, offer no likeness to the history of the Anglo-Saxon. Slavery was a state with laws and customs and ceremonies bearing certain resemblances to our

own, but the negro who has passed through this state to the freedom of American citizenship is, as it were, a man without ancestral history. Instead of cherishing his past and trying to impress its memories and ideals upon his children, he seeks rather to destroy them. He reacts against his past and inhibits it. On the other hand, he has not yet become sufficiently possessed of our civilization to impart its mother-lore to his children. The absence of social restraints, either in the form of crude superstitions or of complex sentiments and ideals, explains perhaps the frequent outbursts of ferocious passions on the part of negroes; the same condition insures also a primitive state of Nature in their children. Scientific research affords proof of the fundamental unity of mind, but it gives no less decisive proof of differences due to ancestry and training. The negro child is psychologically different from the white child. In automatic power he is superior, but in the power of abstraction, of judgment, and analysis he is decidedly inferior. This fact must be recognized in the school training. In purpose and in liberal provision the education of the negro should be the same as that of white children. In detail and method it should be adjusted to the racial plane on which he stands.

But to return to Isaiah. Vacation having ended, he was sent back to school to resume the rehearsal of lessons that conveyed no meaning to his mind. Fortunately, he made a venture for himself and secured the drummer's place in a band; this occupied all his spare time and afforded an outlet for his automatism, with a pecuniary advantage besides. At the end of the year my persuasions added to his strong personal desire prevailed, and he was allowed to quit vain repetitions and go to work. His place in the industrial world is a humble one, for, in spite of the fact that his parents have been willing to give him much more than the average time at school, he has not been raised above the rank of unskilled laborers. This it seems to me is unpardonable. A youth in whom perception, memory, and simple judgment are active might, I am confident, in ten years have been raised a little higher in the scale of independent being. If he had been at Hampton or Tuskegee, the result would have been different, for in these he would have been educated through experiences, social and industrial. In the public schools within his reach he must drill over the elements, to the arrest of development, or go forward to abstract thought of which his mind was incapable. I have dwelt upon a particular case because it is a psychological type. It confirms what the laboratory indicates—namely, if races are to be developed by formal education, its processes must be conformed to their conditions, not *vice versa*.

THE POPULAR ÆSTHETICS OF COLOR.

By JOSEPH JASTROW, Ph. D.,
PROFESSOR OF PSYCHOLOGY IN THE UNIVERSITY OF WISCONSIN.

THE human race, like most large groups in Nature, presents a considerable variety amid a still more fundamental similarity. It is evident that, if only we measure finely enough, no two specimens, however simple, are precisely alike; and in proceeding from the simple to the complex the opportunity for variation and diversity rapidly increases; and yet amid all this diversity of individuals there is much that is common, typical, and similar. In mental processes, with which we are here primarily concerned, it seems fair to expect that, given the same premises and a fairly simple problem, similar conclusions will be reached by different individuals, owing to the similarity of the logical processes involved. But we know very well that when these processes are complex, and particularly when the emotions and interests of men are involved under substantially similar circumstances, very diverse conclusions may be reached, until, in extremely complex questions and in those in which personal interests are dominant, we find *tot homines tot sententiæ*.

Of all varieties of human judgment, the ones generally considered as least subject to rule and most open to caprice are those commonly referred to as questions of taste. These questions of taste refer partly to our individual and peculiar likes and dislikes, and partly to our more strictly æsthetic preferences and aversions. Æsthetic judgments, however, are subject to the influences of heredity and environment, of education, of general mental development, and the like. We speak of certain preferences as childish, as savage, as Philistine, as uneducated, as national, as local, as a fashion or a fad. In some directions it is possible to gather an æsthetic census and determine in a statistical way the distribution of particular likes and dislikes, and to attempt to gain from such material some suggestions of the underlying laws in obedience to which certain sense-perceptions are judged to be more or less pleasure-giving than others. The æsthetic relations and proportions of simple geometrical figures and lines have been studied by this method, and it is very readily applied, as is to be attempted in the present paper, to the study of the nature and distribution of color preferences.

The material for the present study was collected in connection with the Psychological Laboratory of the World's Columbian Exposition, held in Chicago in 1893. The public was invited to record its color preferences by means of a placard, which was

displayed in a well-lighted corner of the laboratory, bearing the inscription shown on page 363.

This method of voting was made possible by having on hand a constant supply of small cards, each bearing a number from 1 to 25, and arranged in numerical order in small boxes or trays. Of such boxes there were two sets, one containing square and the other oblong cards. By means of these devices the *shape* of each card dropped into the ballot box indicated the sex of the voter; the *printed number* on its face indicated the voter's favorite color; the *letter written* on its back, his preferred combination of colors; the *number written* on its back, his age; and the fact that all this information was recorded on one card established the relation between the preferred single color and the preferred combination of colors.

The colors thus displayed were those bearing these names in the series of colored papers prepared by the Prang Educational Company, and to Mr. Prang my obligations are due for very material assistance in this investigation. I am also indebted to Dr. Herbert Nichols and Mrs. M. D. Hicks for the selection and arrangement of the colors and the permission to use the color scheme prepared by them for the study of color preferences. In such a study only a small and somewhat arbitrarily selected range of colors can be conveniently presented, and it is likely that the results may be to some extent influenced by the particular colors among which a choice was requested. Regarding the nature of the colors here presented, it may be noted that the twenty-four single colors fall into two groups of twelve each, the second group forming respectively the lighter shades (in the same order) of the colors in the first group. Each group of twelve colors is composed of the six "primary" or "normal" shades of the colors red, orange, yellow, green, blue, violet, and of six intermediate or transitional colors—red orange, orange yellow, etc. In the color combinations no transitional colors are used, and, so far as is possible in twenty-four combinations, a wide range of grouping and combination is presented.

The material thus gathered, about four thousand five hundred records in all, may be considered from a variety of points of view, and may be made to furnish interesting information regarding the range and distribution of average color preferences. We shall consider first the preferences for the single colors and for color combinations as they occur in the general average, and then ascertain how far these preferences are modified by differences in sex and in age.*

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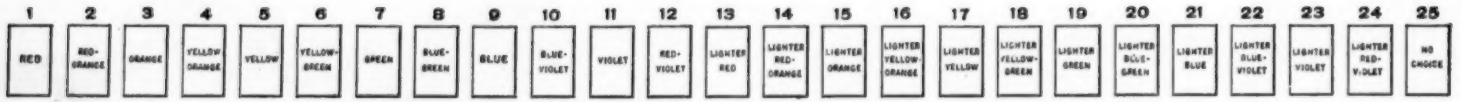
* During the two months or more during which the public was invited to vote its color preferences 4,556 cards were dropped into the box, 2,746 (about three fifths) by men and



STATISTICS OF COLOR PREFERENCES.

First, decide which of the colors in the upper row is most pleasing to you; then take a card with the *number* of your preferred color upon it, and,

Second, decide which of the combinations of pairs of colors is most pleasing to you; then write the *letter* corresponding to your preferred combination of colors upon it; add your *age,* and drop it in the box.

Number 25 and *Letter Y* are provided for those who have no preference.

MEN will please use the *square,* and WOMEN the *oblong* cards.

GREEN / RED — A
BLUE / ORANGE — B
VIOLET / YELLOW — C
LIGHTER GREEN / LIGHTER RED — D
LIGHTER BLUE / LIGHTER ORANGE — E
LIGHTER VIOLET / LIGHTER YELLOW — F
LIGHTER GREEN / RED — G
LIGHTER BLUE / ORANGE — H
LIGHTER VIOLET / YELLOW — I
BLUE / RED — J
VIOLET / ORANGE — K
GREEN / YELLOW — L
LIGHTER BLUE / LIGHTER RED — M
LIGHTER VIOLET / LIGHTER ORANGE — N
LIGHTER GREEN / LIGHTER YELLOW — O
ORANGE / RED — P
YELLOW / ORANGE — Q
VIOLET / BLUE — R
RED / VIOLET — S
YELLOW / RED — T
GREEN / ORANGE — U
BLUE / YELLOW — V
VIOLET / GREEN — W
GREEN / BLUE — X
NO CHOICE — Y

Our first interest lies in determining what colors are the general favorites. The first place is held by *blue*, which is selected as the most pleasing color by slightly more than one quarter of all the voters; and the second place, though not a good second, by *red*, which is chosen by somewhat less than half as many as choose blue. In the next group of most pleasing colors are found *lighter blue, blue violet, red violet, lighter red* (or pink) *violet*, and "*no choice*," while the five least favorite colors are *orange* and its shadings toward red and yellow. In order to illustrate the significance of this result it may be noted that the *four* colors, *blue, red, lighter blue*, and *blue violet*, constitute just about *half* the entire preferences; or, again, if we divide the number of records into four approximately equal parts, *blue* would constitute the first quarter; *red, lighter blue*, and *blue violet* the second quarter; *red violet, lighter red, violet*, "*no choice*," *green*, and *yellow* the third quarter; and the remaining *fifteen colors* would constitute the last quarter of the color preferences.

It will be remembered that the colors presented for selection were divisible into two groups, the one group composed of the lighter shades of the colors of the other group. On comparing the preferences between the two groups it appears unmistakably that the *darker colors are decidedly preferred*. Of every seven persons five choose among the darker colors and only two among the lighter. An equally unmistakable tendency is the preference for the primary colors—i. e., red, orange, yellow, etc.—as opposed to the transitional ones—i. e., red orange, orange yellow, etc.; this preference is nearly as marked as that of the dark above the lighter shades. This seems to indicate that colors more distinctly corresponding to familiar shades and names are apt to be chosen as opposed to those that are less typical and familiar. All these results appear so clearly and strikingly that they may be regarded as possessing considerable general validity.

We may now consider the color preferences of the two sexes. The differences between the male and female preferences are con-

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1,810 (about two fifths) by women. Of these, only 3,043 (1,864 men and 1,179 women) indicated both the preferences for the combination of colors as well as for the single color, and only 2,594 (1,548 men and 1,046 women) recorded their ages. These numbers are suggestive, as indicating that, of all those sufficiently interested to stop and select a color, only *fifty-seven per cent* were careful to follow the entire directions, while just about two thirds did as requested, except that they did not record the age. In all these respects the women are no more nor no less accurate than the men.

The ages of the voters cover a wide range, from six to seventy years. The age best represented occurs at about twenty-two years. One half of all the voters are between nineteen years and six months and thirty-five years of age, and two thirds of them would be between seventeen and thirty-nine years old. The age distribution of the men and women presents no significant differences.

siderable. While *blue* is pre-eminently and overwhelmingly the masculine favorite, it is by no means so general a feminine favorite. The favorite woman's color, standing at the head of the female list, is *red*. Roughly speaking, of every *thirty* masculine votes, *ten* would be for *blue* and *three* for *red*; while of every *thirty* feminine votes, *four* would be for *blue* and *five* for *red*. Red and blue are thus much more nearly equally popular among women than among men. Other relatively marked masculine preferences are for the colors related to blue (blue violet and violet), and other feminine preferences are for lighter red (or pink), and, to a less extent, for green and yellow. Further, men confine their selections to relatively fewer colors than do women; and finally, while all men and women alike are much more apt to choose a normal than a transitional color and a darker than a lighter shade, yet the tendency to do so (about the same in the former direction) is markedly different in the latter respect; of a *dozen* men, *ten* would choose among the darker colors and only *two* among the lighter for the most pleasing color; while of a *dozen* women, *seven* would choose among the darker and *five* among the lighter shades. This feminine fondness for the lighter and daintier shades appears also in other respects, to be noted presently.

Passing next to the discussion of the preferences among the combinations of colors enumerated above, the first noteworthy result is that no combination of colors occupies the position of a decided favorite as did blue among the single colors; but that preferences for the several combinations vary gradually from the most to the least favorite. The two most frequently (and about equally) preferred combinations are *red with violet* and *red with blue*, which are somewhat similar in effect (the violet being very dark in appearance); more than *one fifth* of all the persons contributing to the results choose one or the other of these combinations. The third in the list is *blue with violet*. The three most favorite combinations are those composed of the three colors, *red*, *violet*, and *blue*. The next position on the list is taken by those who are unable to decide upon any one combination as their favorite, and it should be noted that this group is nearly twice as large in the selection of the combination as it is in the selection of a single color. Then follow *lighter red with lighter green*, *red with green*, *lighter red with lighter blue*, and *red with lighter green*. Some one of the above *eight* color combinations was chosen by *three* out of every *five* persons who recorded a preference, the remaining *two fifths* of the preferences being distributed very widely and rather uniformly among the remaining *seventeen* colors. The combinations most generally avoided are *orange with green*, *orange with violet*, *lighter orange with lighter blue*.

Before leaving this division of the subject one further conclusion may be indicated. This relates to the relative frequency of the several colors in the color combinations. Such a comparison is possible only for the normal or primary colors and their lighter shades, and is further hampered by the fact that the several colors are not equally offered for selection in the color combinations. A method of comparison making allowance for these points yields the conclusion that, on the whole, the same colors are preferred and avoided in both the single colors and the color combinations. While the order of preference is measurably the same, we find no such decided favorites as is blue among the single colors, but that the several colors are much more uniformly represented. Red and blue and violet and lighter red are near the head of both lists, and orange and lighter orange at the foot of both. The most striking exception is lighter green, which is very rarely chosen as a single favorite color, but appears frequently in the color combinations. It may also be observed that on the whole the lighter shades of the colors appear relatively more frequently in the color combinations than in the single color preferences, and that this is particularly the case for the women.

The results of the comparison of color preferences for those of various ages are somewhat meager. This is probably due to the wide distribution of age here represented. It is probable that the characteristics peculiar to certain ages could be best determined by recording the preferences of large groups of persons of nearly the same age—a form of investigation that is particularly desirable among children, in whom changes of taste are going on more rapidly than in older persons. For the purposes of comparison the ages were divided into five groups, the number of records in each group being approximately the same. The groups thus formed are for the youngest, eighteen years and below; the next, nineteen to twenty-four years; the third, twenty-five to thirty years; the fourth, thirty-one to forty years; and the oldest, forty-one years and above. The most noteworthy characteristic of the color preferences of these groups is their general similarity; but there are four indications which are sufficiently marked to be probably free from chance. These are, that *blue* is least selected by the youngest group, about equally by the three middle groups, and decidedly preferred by the oldest; that *violet* is gradually avoided as age increases; that those who make most use of the "no choice" column are between twenty-five and thirty years of age; and that *lighter red* is particularly preferred by those below eighteen years of age. It is equally difficult to detect any marked differences between the sexes respecting their color preferences at different ages, but it is perhaps not accidental that in these results the liking for *pink* (*lighter red*) is confined to young girls,

and does not appear among boys, and that lighter violet is more distinctly preferred by the older women than by the older men.

The method of collecting these preferences, it will be recalled, enables one to know the combinational color preferences of the individuals who choose a given color as their favorite. It is thus possible to study the correlation that may exist between the choice of a single color and the choice of a color combination. It will not be worth while to do this except for those colors that are chosen by a relatively large number of individuals. Taking, for example, those who choose blue as their favorite color, we find what combination of colors these "blue-choosers" were most prone to select, and so on for those who chose red, lighter blue, blue violet, red violet, lighter red, violet, and green. The first marked result of such a comparison is to show that the *favorite color is extremely apt to reappear in the combination of colors.* The evidence for this may be given in some detail. If we represent by 1 the proportionate choice of a combination having the color blue in it in the general records, we find that the number expressing how many of the "blue-choosers" would also choose a combination in which blue occurred would be 2·17, or more than twice as many as the general average. So for *red* it would be 1·87, for *lighter blue* 3·98, for *lighter red* 3·82, for *violet* 2·85, and for *green* 4·44; or on an average 3·18, which means that a person who has chosen any one of the above colors as his favorite color is more than three times as likely to choose a combination in which that same color appears as is the average chooser. It also appears that the men obey this tendency slightly more than the women.*

Having found characteristic differences between the single color preferences of the sexes, we are prepared to find them as well in the preferences for color combinations. On the whole, the order of preference of the combinations of colors for the men and for the women is very much alike; and when they differ it is frequently doubtful, especially when the combination of colors is rarely selected, whether such differences are accidental or not. Of the masculine preferences those which seem most decided

* Several other "correlation" conclusions may be drawn, of which the following are the most interesting: It appears that the men who are rather exceptional and choose a color which is a common feminine favorite, and the women who select a typical masculine color, are more apt than the more conforming choosers to retain this color in their color-combination preferences; it also appears that the tendency to retain this favorite color is limited to the same shade of color and does not apply to a different shade of the same color, and it further appears that those who select a favorite color which is selected by a relatively large number of persons are more alike in their combination preferences—i. e., they confine their selections to a more limited range of color combinations than those whose preferred color is not a popular favorite.

are for the *red with blue* combination and the *blue with violet*, there being *five* men to *one* woman choosing the former, and *three* men to *one* woman choosing the latter; while the most marked feminine preferences are for the *lighter red with lighter green*, *red with green*, and *red with lighter green*, there being nearly *four* times as many women as men choosing the former, *twice* as many the second, and *two and a half times* as many the last of these three. We observe in these differences the reappearance of the masculine preference for *blue* and its related colors, and the feminine preference for *red*, and also the feminine preference for the lighter colors. The liking for combinations of red with green in their various shades seems also a particularly feminine fondness.*

In reviewing these results of this popular census of color preferences, it is apparent that while in some directions the conclusions seem clear, suggestive, and interesting, in others their interpretation and value are at present doubtful or defective. It must, however, be borne in mind that these returns have been gathered among the general public and by only one of several methods; their full significance can hardly appear before special studies shall have been made of the influences upon color preferences of age and nationality, of education and special artistic endowment, of conventionality and association, and of the many other factors that contribute to the complexity of even the simplest æsthetic judgments. For the present, the results are presented as merely an initial contribution to the statistical study of the popular æsthetics of color.

AN interesting case of mimicry is described by Mr. Charles A. Witchell as shown in his brother's Dandie Dinmont terrier, which was in the company of a fine mastiff for a short time when young. "The little dog was somewhat awed by the great beast, which could easily have made a meal of him; but he was evidently very proud to be allowed to accompany her for a ramble in the country." In a short time he began to try to reproduce her baying, which was much lower in pitch than his bark, and made very great efforts to accomplish it, which he finally did very successfully. "He raised his head and uttered a great bark, about an octave in pitch below his usual tone. All his breath was exhausted by the effort, and he immediately coughed, as though his larynx had been strained." Mr. Mitchell also observes that when one of the fish in his aquarium gaped, any other one near would be tolerably certain to gape soon afterward.

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* It is possible to calculate for the men and women separately the tendency to select given colors in the color combinations (irrespective of the colors with which the given color may be combined). Such a comparison yields the conclusion that the colors relatively better represented in the combinations of color than in the single colors are, for the men, *blue* and *violet*; and for the women, *lighter red*, *lighter yellow*, and *green*.

EVOLUTION OF THE CARRIER PIGEON.

By M. G. RENAUD.

THE exhibition at the Trocadero and the dispatches of pigeons recently made at sea have attracted public attention to what may be called *columbophilism*. They have, moreover, revealed the existence of many flourishing societies that display their activity in the training of hundreds of thousands of pigeons. It is worth while to inquire into the motives which have provoked this enthusiasm concerning these birds.

Messenger pigeons are certainly of great service in time of war as means of communication between different parts of the army and the country when the telegraph lines have been broken. But this does not account for the great extension which has taken place in the last few years in pigeon-training. Belgium, for example, has as many pigeons as all the other European countries put together. But in selecting and training the best varieties of pigeons the Belgians have not been actuated solely by considerations of national defense. Their interest in their favorite sport is largely determined by the excitement of gaming, and their Sunday pigeon matches are occasions of much betting. Very few persons think now of utilizing the pigeons for purposes of daily life. They have the telephone, telegraph, and mail; why should they go back to so primitive a method of correspondence? Hence an excuse is devised for relegating the pigeon to the category of luxuries. We hope to show that it is something more important. We believe that relations of every kind would gain much in convenience if the pigeon was employed concurrently with the most improved means of correspondence. This useful messenger might in many cases supplement or even take the place of the post and telegraph. The most elaborate system of telegraph lines can only serve places of a certain degree of importance, and they are not built to effect connections the use of which is not constant or profitable enough to justify the expense of constructing and maintaining them.

Most valuable use has been made of carrier pigeons in the past. The ancient civilized empires of Asia included many perhaps relatively well settled regions infested by robbers and extensive deserts through which well-armed caravans passed but inconveniently and where the most secure means of communication was by means of these birds. The Greeks borrowed the use of pigeons from these nations, and an Eginetan athlete sent home the news of his victory at Olympia by means of one of them. The Romans had a system of optical telegraphy and supplemented it by pigeons. The use of this aërial post became more and more general toward

the end of the empire. In the middle ages the news of the capture of Damietta by St. Louis was announced to the Sultan by this means. At a later date pigeons rendered important services in sieges like those of Haarlem and Leyden. The pigeons of St. Mark have been taken care of since the thirteenth century in recognition of the services which they rendered to the republic during the siege of Candia by Dandolo. During the continental blockade the financiers of the continent kept up communications with their London correspondents by pigeons. After normal national life was restored to Europe and as the improvement of communications went on, the service of the pigeon post was neglected till the siege of Paris in 1870 called it to life again. But the fishermen of Boulogne, Dieppe, and Saint-Malo still send pigeons forward in advance of their boats as they are returning home, with reports of what their catch has been.

The birds that stock our pigeon houses are of the Belgian breed, which has been developed by centuries of selection from the rock pigeon. This breed differs much from its wild ancestors in habits and instincts. The carrier pigeon is not quite so large as the ring pigeon, but has a more expressive head, more elegant form, and a more brilliant and more varied plumage. The training of the young pigeons begins when they are three or four months old. They are let loose at gradually increasing distance, all in one direction, from the pigeon houses. At six months of age one should be able to return from a distance of two hundred miles at a speed of fifty miles an hour. At the end of the second year it should come back from distances of more than three hundred miles, and of the third year from six hundred miles. Pigeons return more rapidly from places lying in the direction in which they have been trained. Training in one direction has some advantages and several disadvantages in practice; but as the trainer of to-day is not seeking useful results, but simply to beat in the races, he adopts the method best adapted to his purpose. As the races at the same city always take place over the same course, why take the trouble to give the birds a various training? Under the stimulus of the races and through the training for them, a great improvement has been effected in the quality and powers of pigeons.

Two interesting questions present themselves concerning the length of time during which the pigeon can recollect the place of his home and the distance from which he is able to find his way back to it. Some birds have found their way home after five years' absence; and it is generally considered that good birds can be depended upon for six months. Pigeons have returned from Vienna and from Rome to Brussels, and others, sold to be carried away to America, have made their way back to their original owner in Belgium.

When pigeons were to be sent back and forth, it has been usual to keep two sets, with their respective homes at either end of the course; and when they have reached their home, to carry them back to the places from which they are to be dispatched. An ingenious process has been devised to overcome this difficulty and cause the birds to fly with equal certainty in both directions. Pigeons, for example, whose home is in Paris are confined for several days at St. Denis, and fed there at a stated hour every day with some favorite food which is not given them at their real home. They become in the course of time familiar with their new home and its choice dishes. When set at liberty, they start off at once for Paris, without forgetting the good things they enjoyed at St. Denis. When they are to be sent back, they are made to fast a little while, and are then let loose at about feeding time at St. Denis. They go thither, and, when they have their own way, time their going so as to be there at the exact moment of feeding. Birds have thus been taught to fly back and forth regularly between places thirty miles apart.

When a carrier pigeon is set at liberty at a distance from its home, it rises in the air, describing a spiral, higher and still higher, then takes a start. In about a quarter of an hour it will be seen again directly above the point at which it was freed. It starts thence anew, and takes the right direction without hesitation. Compare this quickness of decision with the embarrassment experienced in a strange region by an intelligent man who has read up about the country and is fortified with all the knowledge concerning it that science can give him!

The sense that guides the pigeon in its direct return to its home is as much a mystery as it ever was. It is not sight, for the bird at its highest flight can not command the vision of a single familiar object or place. Theories of electric currents have been imagined and other methods of analyzing and explaining the instinct have been devised, but they are all alike conjectural and insufficient. But while we do not know the cause or the method of the faculty, we have it in our power to modify and direct it in a certain degree. To the wild pigeon, which goes far in search of food, the power to find its way back to its nest is a necessary condition to its existence. The domestic pigeon does not have to go long journeys for food, but its return home is nevertheless determined by this question. The best fliers are those which are least competent to pick up anything to eat on the road. The sense of orientation—the homing sense—has been cultivated and bred in them at the expense of other faculties which have become less useful to them. While very poorly armed to contend with the conditions of a wild state, the carrier pigeon is perfectly equipped for its present conditions of existence and for the services that

are demanded of it. Its faculties have been developed and specialized in the direction sought by the breeder. Man does not create in selecting; he exerts no immediate influence on the production of variability. He contents himself with exposing organized beings, for a special purpose, to new conditions of existence. Nature then acts on the organization and causes it to vary. Man chooses the variations which Nature furnishes and accumulates them. This is the principle, the application of which has given us races of pigeons with very different aptitudes. For example, French and Belgian breeders select with a view to success in the races, and often specialize the instinct of their pigeons. Birds from the same stock will, for instance, be trained for generation after generation to the east-to-west direction; and if we take a pigeon without being acquainted with the special aptitude of its ascendants, and try to train it to the north-to-south direction, we shall probably meet with mishaps. In England, where much fog prevails, the breeders keep only the birds that can fly through a misty atmosphere. The English breeds have consequently a capacity for finding their way in weather which would often baffle the pigeons of other countries. For like reasons pigeons raised in Sweden and Norway are able to return to their homes in the face of snow, which often puts the instinct of French pigeons to fault. The training of pigeons at sea requires special aptitudes, which a rational breeding will develop by selection.

We read in books on pigeon culture that the carrier pigeon is hardly ever white. The reason for this is very simple: pigeons on their journey are selected by birds of prey, which most readily pick out those of conspicuous colors; consequently these birds disappear without having opportunity to found a stock. This observation does not apply so much to the common pigeon, which, never straying far from habitations, is less frequently struck by the hawk. So pigeons flying near the ground are certain to fall sooner or later under the shot of the hunter, and usually leave very few descendants. This circumstance, independent of our will, often intervenes to play an important part in the transformation of a domestic species.

Selection permits us to adapt our races to any sort of service. We might, for example, create a stock of birds that would retain the recollection of their home for a very long period; we might develop the aptitude for traveling back and forth. We have sometimes asked ourselves what limit could be fixed to the utilization of the carrier pigeon. To fix a limit would be to deny the principle of transformability of species, which is a law of evolution. Our races are continuously undergoing modification, and are consequently capable of indefinite improvement. Instead of looking for limits to the employment of the pigeon, we should point out

some practical object to the trainers, and tell them simply we want birds that will come back in all weathers, in every season, and from all points in the horizon. Our demand would be promptly fulfilled. The bird is very prolific, and the task of the trainer is further facilitated by the fact that pigeon-matings are for life, unless the couples are forcibly separated; and it is therefore possible, without difficulty, to keep many varieties distinct in the same pigeon house.—*Translated and abridged for the Popular Science Monthly from the Revue des Deux Mondes.*

SPIDERS AND THEIR WAYS.

By MARGARET WENTWORTH LEIGHTON.

Spider,
At my window spinning,
Weaving circles wider, wider,
From the deft beginning;

Running
Rings and spokes, until you
Build your silken death-trap cunning—
Shall I catch you—kill you?

Sprawling,
Nimble, shrewd as Circe;
Death's your only aim and calling,
Why should you have mercy?

Strike thee?
Not for rapine willful:
Man himself is too much like thee,
Only not so skillful.

—George Horton's *Songs of the Lowly.*

NOT so skillful, and doubtless never will be, for to-day a spider's thread is used in the telescope because man has been unable to manufacture one so fine and delicate.

Whenever I look at the marvelous web of the great black-and-gold garden spider I remember that pretty story of the way in which the group of spiders received its name of *Arachnidæ*. In the olden times there was a lovely maiden named Arachne, who could weave and embroider with such deftness that the nymphs all gathered to watch her. They whispered to each other that she must have been taught by Minerva herself, who was the goddess of Wisdom. Arachne overheard them, and, denying their accusation, challenged Minerva to a trial of skill. Minerva accepted the challenge, and when the webs were woven Arachne's was wonderfully beautiful, but Minerva's far surpassed it.

Arachne was in despair and hung herself, whereupon Minerva's chagrin was so great that she transformed her into a spider, and her descendants preserve much of her skill.

We are apt to think of spiders as insects, but really they are only distantly related to insects, their first cousins being scorpions and king crabs. The spider's body consists of two parts. It has four pairs of legs, a pair of palpi, and a pair of mandibles. The legs are jointed, and on the last joint there are three claws. The palpi are used as feelers and to hold the food. The breathing apparatus of the spider is a combination of lungs and gills. It has glands containing poison which lie partly in the head and partly in the basal joint of the mandibles. There is a tiny opening in the claw on the mandible, out of which the poison flows when the spider captures its prey. It has eight eyes. The spiders are classified largely by the different arrangements and grouping of the eyes. Some have them in one or more clusters, some in rows, and others scattered about. They appear to be able to see as well by night as by day. Near the end of the body are the spinnerets—two, three, or four pairs—out of which the silk comes for weaving the webs, nests, and egg cocoons.

SPIDER'S CLAW, ENLARGED.

Usually the female spider is much larger and stronger than the male. One naturalist thus graphically describes their wedded life: "Their honeymoon is of short duration, and is terminated by the bride's banqueting on the bridegroom. Doubtless she evinces taste and discrimination in her appreciation of a 'nice young man.'"

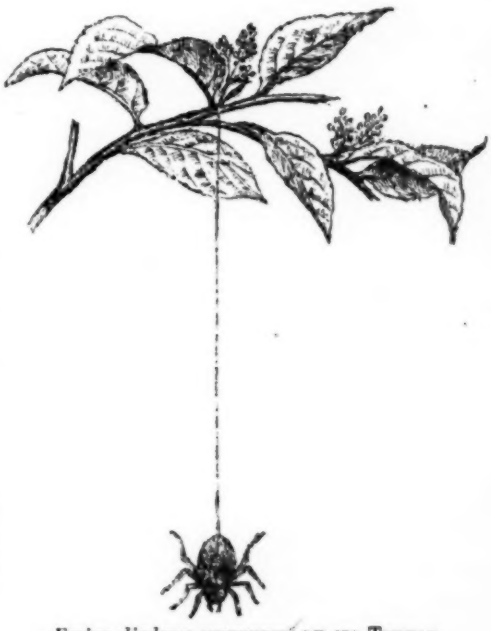
Spiders, like lobsters and other crustaceans, have the power of reproducing certain parts if they happen to meet with an injury, as legs, palpi, and spinnerets.

We find as marked differences in habits, tastes, and characters among spiders as among human beings. Some kinds prefer always living in houses or cellars, not seeming to care for any fresh air or out-of-door exercise. Mr. Jesse tells of two spiders that lived for thirteen years in opposite corners of a drawer which was used for soap and candles. Others delight in making burrows in the earth, in dwelling under stones or behind the loose bark on trees, and others live under water. Many never leave their webs, but patiently wait, hoping some insect will become entangled in the snares they have set. Others dash about and seize upon every luckless insect that crosses their path. The most adventurous of all are those that sail out into the world on one of their own little threads. Darwin tells of encountering thousands of them many leagues from land when he was taking his famous

voyage in the Beagle. He says: "The little aëronaut, as soon as it arrived on board, was very active, running about, sometimes letting itself fall, then reascending the same thread. It could run with facility on the surface of the water."

In the bright autumn weather, if we observe closely, we may sometimes see some of our own small spiders ascend to the tops of trees, fences, and other high objects, rise on their toes, turn the spinners upward, throw out a quantity of silk, and sail away. They can be seen plentifully any fine day in October or November, before the cold weather, on Boston Common. They grasp the silken thread with their feet and seem to be enjoying themselves as much as the birds and butterflies.

Many instances are recorded of music-loving spiders, perhaps the most interesting being that related by Beethoven's biographer, who says: "A spider weaving its skillful though delicate trap for its daily dinner worked industriously in the corner of the ceiling until Beethoven began to play. Beethoven, who at that time had not thousands hanging on his baton, was rather pleased and attached to this listener, which most practically proved the value it attached to the performance by risking its life in coming nearer the enchanted instrument. And ill was it rewarded. The mother one day, perceiving the ugly animal, seized and killed it. But the boy Beethoven was so put out and so miserable at losing his strange auditor that he burst into tears and, seizing his violin, smashed it against the floor, shivering it into a thousand pieces."

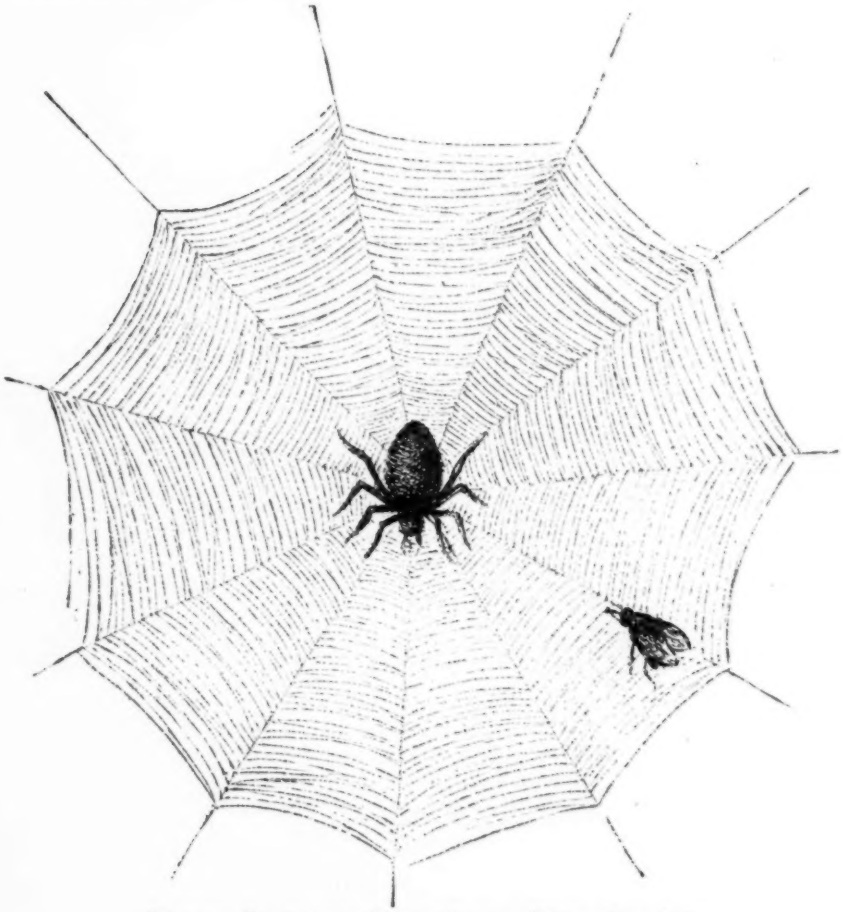


Epeira diadema SUSPENDED BY ITS THREAD.

Many kinds build their webs and cocoons in exposed places and take no pains to conceal them, while others cover theirs with tiny pebbles and bits of earth for protection. Some kinds of spiders abandon their egg cocoon as soon as it is finished, while others carry it about with them until the babies appear. One mother allowed herself to be torn to pieces rather than leave her cocoon.

We might compare the spiders' different modes of getting

about to those of the birds. The hunting spiders leap and hop, the house spiders generally run forward, other kinds run backward and sideways with equal facility, and some, as we have seen, float about in the air. The most marvelous of the spiders' gifts is the silk-spinning. The spinnerets or spinners are little organs at the hind end of the body. Each has a number of very minute holes in it. Out of these the silk flows in a liquid form, but as



SNARE OF LONG-BODIED GARDEN SPIDER, *Tetragnatha extensa*.

soon as the air strikes it it hardens into a thread. The strands from the different holes all unite and form what we know as the spider's thread. There are great differences in the kinds of webs and nests which different spiders make. One of the most interesting is the web of the great black-and-gold garden spider. First she spins several lines all joined in the center like the spokes of a wheel, and attached to stems or leaves of plants at the outer edges. When the rays are finished she begins at the middle to

make the spiral part. It is fascinating to watch her, as she crosses each spoke, stop and pat down the silk once or twice, then pull it to see if it is well secured before passing to the next one. When the web is finished, she makes a zigzag ladder of white silk, running from the bottom outer edge to the center. When she hangs in the middle of her web, as she does much of the time, the ladder helps to conceal her. The web is made of two kinds of silk—one smooth, the other covered with an adhesive liquid. When the insects are caught, their legs and wings are soon covered with the sticky juice, so that it is impossible for them to escape. The spider, knowing it would not be convenient to become entangled herself, spins one long, smooth thread from the center to the outside, which she uses in traveling to and fro.

The common house spider is wonderfully sagacious. Once in a while a large insect is caught in her web. She wants to take it up to her inner retreat to devour, and it is too heavy for her to carry. What is she to do? First she bites its leg, injecting some of her poison, which stupefies it. Next she throws some additional threads about it and ascends to the top, pulling the thread as hard as she can. When she has rested for a little time, she winds more threads about her victim and pulls again, each time attaching the threads at the top. In this way she finally succeeds in hoisting her feast into her house, though the process may last several days.

Who would think that our predecessors in the art of curling the hair were spiders? One species has been provided by Nature with a sort of little curling comb called the *calimistra.* It is on the hind legs and consists of two rows of parallel spines. The web, which she makes of bluish-white silk, is unusually pretty, as each thread is gracefully curled by drawing it between the spines.

Thoreau calls the little gossamer webs which we see spread over the grass on a dewy morning the napkins of the fairies. Even Chaucer, who wrote five hundred years ago, mentions them as a great curiosity to the people of his time. He says:

> As sore wondren som on cause of thonder,
> On ebb and flood, on gossamer and on mist,
> And on all thing, 'til that the cause is wist.

A hundred and fifty years ago a Frenchman, M. Le Bon, made some stockings, purses, and gloves from spiders' silk. The Bermuda ladies use the thread of *Nephila* for sewing, and Queen Victoria was presented by the Empress of Brazil with a dress made of spiders' silk.

Spiders molt several times, each time appearing in a different color. We should hardly expect to find very brilliant or showy

colors among them, yet some of them are gorgeous in the extreme. A little crab spider that built a house in my garden was the brightest lemon-yellow all over, and shone like a jewel amid the dark green of the surrounding foliage.

One of the English spiders has a black head and thorax, with an orange-red body, on which are six black spots, each ringed with white; another has a green coat with brilliant red and yellow striped trousers, for all the world like a king's jester. One dainty lady is clad in violet and white, a flaunting miss in black and flame-color, and her sister in cherry and brown.

Some of the *Thomisidæ* are the exact colors of certain flowers, in the centers of which they sit all day, watching for the insects that come to get honey.

Two of the spiders' worst enemies are mud wasps and ichneumon flies. In searching recently for spiders beneath the clapboards on the south side of the house, I came across one of those curious structures which the mud wasp builds. I broke it open, and out tumbled a quantity of small spiders. The wasp's storehouse was in three compartments, and all together contained forty-nine spiders, all of the same kind and about the same size, in a torpid condition. The wasp had laid an egg in each of these spiders. She does not kill the spider, but merely stupefies it, so that when her egg hatches the larva may feed upon the luckless spider.

If one be a student of Nature he will perhaps have noticed a spider rush away and hide in her crack without any apparent reason. The moment before she had been enjoying the bright sunshine, and the student wonders why she ran away. The spider's perceptions are so keen that she knows long before he does that the sky will soon be overcast and torrents of rain descend or a cold wind begin to blow. If she stayed out she might soon be benumbed and unable to run into her house.

The water spiders are covered with hairs which shed the water, so that they never get wet. The little house under the water in which they live and raise their families is as snug and dry inside as yours and mine.

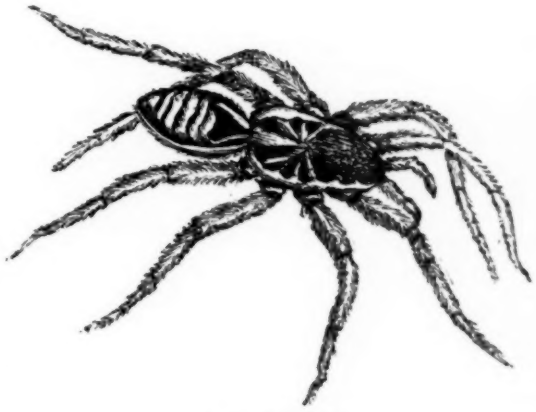
No spiders are more interesting than the trapdoor spiders and their first cousins the tarantulas. The former live in Europe and California. First, they make a burrow in the ground and then build the door. The California ones make their door of mud and sticks. It fits into the tube as a cork does into a bottle. The covers built by the European species are mere little lids, but they are always built so as to resemble the surrounding surface. One kind shows her sagacity by building a sort of double door, by which she can escape should an enemy storm her fort. At the surface is the usual door, and a few inches below this another.

When the spider hears an enemy investigating her burrow, she runs below the second door and pushes it up, so that the marauder will think he has happened upon an empty nest, the second door forming the bottom of it. The babies are born in the tubes, and remain with their mother until they are able to make nests for themselves.

These spiders spend the days in their burrows, but at night they all flock out to enjoy themselves. They fasten open their doors and make little webs over the grass. Many night-wandering beetles are caught, and then comes the banquet, which consists of the softer parts of the beetles. In the morning the closest observer could not find a trace of the preceding night's revelry, so carefully have the spiders cleared away all webs, beetle legs, and wing covers.

One group of spiders is called *Lycosa*, which means wolf spider. Perhaps they were named from the similarity of their habits to those of the wolf, being like him wandering and predaceous.

One of these is the tarantula, a great hairy fellow who inhabits warm countries. The species received its name from the Italian city of Tarentum, where they have been found in large numbers. There is a curious superstition connected with the tarantula's bite. If a person was bitten it was thought nothing could save his life but the playing of some lively dancing tunes. When he heard these he was supposed to be unable to resist the temptation to dance. Thus he grew very warm, and the perspiration came out in great beads all over him, each bead filled with poison. After he had danced as long as he possibly could, the poison had all escaped from his system. The tarantulas feed on small birds as well as insects. Indeed, one of the great southern species is called the bird-catching spider.



Lycosa tarantula.

In India, where all animals are treated with consideration and even reverence, the little children often keep these spiders for pets. They tie a cord round a spider and lead it about, feeding it with worms and insects. Mother *Lycosa* always carries her egg

cocoons out with her on her hunting expeditions, attached to the spinnerets.

Last summer I kept a garden spider for three weeks under a tumbler, and had the pleasure of watching her building her house of snowy silk, with its three entrances, and raising a large family of children. She soon learned to take flies from my hand and drink water from a leaf which I gave her fresh every day. After a time she seemed to languish and droop, so I set her free in the garden once more.

> If you wish to live and thrive,
> Let a spider run alive,

says the old Kentish proverb.

PETROLEUM, ASPHALT, AND BITUMEN.*

By M. A. JACCARD.

PETROLEUM, asphalt, and bitumen may be regarded as so related to one another, so like in origin and properties, as to be capable of being considered in the same treatise; and we may, therefore, speak properly now of one, now of the other. The oldest known form of natural hydrocarbon was the bitumen which rose to the surface of the Dead Sea, called from that circumstance the Asphaltum Lake. Tradition says that it used to appear on the surface in considerable masses, and was collected by the Arabs and exported to Egypt, where it was used in embalming, and for a few purposes in the arts. The ancients were also acquainted with the liquid form of bitumen, petroleum. Herodotus speaks of the mineral oil of Zante; and other Greek authors mention the springs of Agrigentum, the product of which was burned in lamps, and was known as Sicilian oil. The fire worshipers of Persia erected temples over the burning springs.

Of the use of these substances in the middle ages, and later, we chiefly know that the petroleum springs of Pechelbronn, in the sixteenth century, spontaneously furnished mineral oil in such quantities that the peasants around used it to feed their lamps and grease their carriage wheels. The virtues of the mineral springs of the Jura Mountains were made known in 1712 by a Greek doctor, who pronounced them a treasure that had been unknown from the beginning of the world. Since then new sources have been discovered in all parts of the world, and the

* From Le Pétrole, le Bitume et l'Asphalte. Par A. Jaccard, Professeur de Géologie à l'Académie de Neufchâtel. Paris: Félix Alcan, 1895.

uses and applications of petroleum have been immensely and wonderfully extended. The discovery of the American beds of petroleum and the application of industrial processes of distillation to them have been the beginning of a new industry, and of largely extended researches in all countries. Leopold von Buch (1801), who seems to have been the first to discuss the origin of the natural hydrocarbons scientifically, supposed that they were of animal origin. Violet d'Aoust, in 1814, believed them to be of the same origin as the rocks with which they were associated, native eruptive products, the resultants of causes still unknown; and repeated this opinion ten years later. Puvis thought, in 1836, that bitumen penetrated the rocks, according to their porosity, after their formation. Rozet, in 1836, thought that the bitumen of Pyrimont was sublimed from the depths of the globe through a crack that marked the direction of the formation, and was condensed in the porous rocks. Millet, in 1840, thought the same bitumen was derived from the decomposition of accumulations of vegetable matter, and ran down through the rocks. Itier, in 1839, supposed that the bitumens of the Jura were derived from the adjacent bituminous schists, which were full of vegetable fossils. Daubrée, in 1850, believed that the mode of their formation was similar to that of coal, but admitted the possibility of their having been derived from mineral synthesis. These views and the theory of volcanic origin have been reiterated in various modified shapes by other authors. M. Lartet published, in 1866, a valuable study of the geological relations of the bituminous deposits of the region of the Dead Sea.

When the mineral oils of the United States had become a prominent subject of attention, Mr. Leo Lesquereux made an elaborate discussion of them in the form of a letter to Liebig, in 1865, in which he gave his reasons for supposing that they were the products of the decomposition of marine plants. Dr. Sterry Hunt about the same time concluded, from an examination of the petroleum beds of Kentucky, that the oil, or the organic substances from which it was produced, were deposited in the strata where the oil is found contemporaneously with the formation of the rock. Mr. Orton, after a thorough study of the petroleum of the Trenton limestone of Ohio, published his conclusion in 1884, that it was of organic origin—derived from the decomposition of vegetable and animal matter. The supply could not be renewed, and was therefore not inexhaustible. It was probably produced at the ordinary temperature and not by distillation.

Some authors, assuming that these hydrocarbons are derived from the decomposition of organic matter, have tried to imagine the manner of the process, and to distinguish between it and ordinary or putrefactive decomposition.

It is apparent that nothing more than the value of a hypothesis can be attached to these speculations. Nothing indicating sublimation has been observed where the theory supposes it to have taken place; the operation of a natural chemical distillation is not proved by any evidence of such a process having anywhere taken place. The opinions of MM. Daubrée, Lartet, and Coquand, in favor of a chemical origin, being based upon studies of the formations themselves, are regarded as being of more substantial value. These authors, however, are judged to have erred in confounding the original formation of the substances with their appearance where they are found—which, in the view of the author, are two very different affairs.

A bituminous limestone of the Val de Travers, Switzerland, is formed almost wholly of shells, *echini*, and similar fossils, held together by a calcareous cement. Some of these fossils are only casts, the shell having been absorbed, while the interior, otherwise empty, is partly filled with a viscous bitumen, the quantity of which is proportioned to the size of the shell. In the smaller brachiopods there is only enough to color the inclosing rock a chocolate brown; in the larger ones it forms a lump which is softened by warming. The bituminous limestone of Auvernier is marked by infinitely numerous little cavities, such as are seen in tufas, which are made visible by the presence of a brown substance, the residue of a volatilized bitumen. It also contains casts or impressions of fossilized shells, and in these again are deposits of brown or blackish substance—the organic matter of the mollusk, transformed into bitumen. The cavernous or breccialike rock of Bevais, a few miles south of Auvernier, contains what we might perhaps call glutinous inclusions—cavities corresponding with the internal part of the fossils, colored brown with organic matter. There are also real pockets of viscous bitumen, which liquefy under a slight increase of temperature. A closer examination of the cavity shows that it is the result of the destruction of an astræan polyp. Of the association of petroleum and fossils in the United States, an observation has been recorded by M. Daubrée of petroleum occupying the cavities of fossils—orthoceratites, brachiopods, and corals, as well as porous parts of the rock—in some of the beds of the Ohio Valley; and a statements by MM. Fuchs and Launay, that "a remarkable characteristic of the Canadian oil is the profusion of remains of mollusks and crustaceans, with some traces of marine vegetation, which it contains. This is one of the most serious facts on which an organic origin is attributed to petroleum."

Of the occurrence of these hydrocarbons, including also natural gas, a review of all the theories and evidences leads us to the conclusion that stratified deposits of asphalt, bitumen, and petro-

leum are found in the different countries of the globe, often associated with salt, gypsum, sulphate of iron, and mineral springs. A considerable number of these deposits are asphaltic or petroleum-bearing basins, of greater or less richness, the working of which requires the boring of wells, or the excavation of galleries, permitting a tolerably exact determination of the manner of occurrence of the substances. Nowhere do the works furnish any evidence of the existence of reservoirs or cavities comparable to the caverns of mountainous regions; but everywhere the hydrocarbons are in the state of impregnation or mixture with the rocks in which the workings are made. When they exist in a viscous or solid condition, there is reason for presuming that this state or manner of being is due to particular phenomena of concentration operating at the moment of deposition or after it. The existence of veins or of eruptive beds, ancient or recent, is nowhere established in a certain and indisputable way, but it may be that fissures existing in the rocks have been filled, either from above or laterally, by a posterior displacement.

In attempting to account for the origin of the hydrocarbons, a distinction may be made between two states in which they present themselves, whether on the surface or in the depths of the soil. The initial state, or that of formation, is represented in the stratified beds, where a series of superposed layers is presented. The substance exists, impregnating the rock, and, more rarely, in viscous or solid bituminous masses. The second state, that of alteration or transformation, is met in the beds which have been modified by dislocations, posterior to the solidification of the matters which were deposited in a movable or plastic state. To these dislocations may be attributed the natural petroleum wells which have been known from antiquity, as well as the flows of viscous bitumen which in some regions become solid on exposure to the air.

The slow distillation of marine bodies may be likened, to a certain extent, to the processes of conservation of fossil wood in the bottoms of marshes, peat bogs, etc., under the mud. But while the absence of air is sufficient to assure the preservation of these, the presence of an entirely impermeable envelope is necessary to prevent complete decomposition into volatile gases such as takes place with all animals simply buried under water.

The presence or existence of natural springs of petroleum in the vicinity of mountainous regions is explained, not by dislocations of the ground, but by the fact that the formation of the reliefs is anterior to that of the mineral oil. Instead of regarding these springs as available as guides in researches, they should be regarded as signs of the approaching exhaustion of the arenaceous strata impregnated with oil; these reservoirs not being suscep-

tible, like those of our springs, of being refilled, as the springs are kept full of water by the penetration from the surface.

If, then, we put aside the eruptive process as not well founded, it follows that the search for petroleum should be made with account taken of the conditions of formation of the sedimentary beds, of the extension of the basins in which they are deposited, and of the formations over them.

While the natural hydrocarbons are indisputably found in the sedimentary beds, from the most ancient to those which are still in process of formation, it is nevertheless certain that so far they are most extensive and most generally distributed in the Tertiary formations—excepting always the Silurian and Devonian deposits of North America, which were formed under geophysical conditions which have not yet been recognized in other regions where formations of the same age exist.

In a general way, the signs of the existence of solid, liquid, or gaseous hydrocarbons, exhibited by mud volcanoes, disengagements of natural gas, etc., authorize the presumption of beds near the surface, so that it is useless in such cases to anticipate a favorable result from deep borings.

All the facts noted by students of the natural hydrocarbons may be explained without difficulty under the hypothesis of the organic origin of the natural hydrocarbons, which becomes a complete system, the value of which imposes itself upon every one seeking the solution of the question. All is easy of conception if we suppose a simultaneous precipitation of mineral matters and organic substances derived from the decomposition of animals and plants, when these are found in suitable conditions of the medium and of their own being at the moment they are buried. But all becomes obscure and inexplicable under the hypothesis that these substances are formed in the depths of the globe under the influence of a high temperature and considerable pressure.

CAPTAIN F. E. YOUNGHUSBAND is a scientific explorer of much experience in the mountain regions and high plateaus of Central Asia, who has observed the men as well as the topographical features and natural history of those regions. He declares in his latest book that while the traveler sees in his journeys every step of the ladder of human progress, from men who are little more than beasts of burden to the statesmen, men of science, and men of letters of the first rank in the most civilized countries of the world, he has "not been impressed with any great mental superiority of the most highly developed races of Europe over lower races with whom I have been brought in contact. In mere brain power and intellectual capacity there seems no great difference between the civilized European and the rough hill tribesmen of the Himalayas; and in regard to the Chinaman, I should even say that the advantage lay on his side."

A CURIOUS CANADIAN IRON MINE.

By J. T. DONALD, M. A.

THE province of Quebec in the Dominion of Canada is sometimes known as French Canada, because of the rights and privileges granted the inhabitants of French origin when Canada passed into the possession of the English crown, and because the majority of the inhabitants are of French ancestry and speak the French language. Time has flown, but in many parts of Quebec language and customs have remained stationary. To-day the student of language or of folklore or of ballads finds large portions of French Canada what old France was a century or more ago; and just as the student of the French language can hear spoken to-day the French tongue as it was spoken a century ago in old France, so the traveler who visits the historic district of Three Rivers may turn back the hand of time, as it were, and see to-day the mining of iron ore, and until recently the smelting also, carried on exactly as in the Old World decades ago.

At Three Rivers, not far from midway between the cities of Montreal and Quebec, the St. Maurice flows from the north into the St. Lawrence. The lower portion of the valley of the St. Maurice is historic ground in the annals of iron-smelting on this continent. The immense deposits of bog ore of this district were objects of attention during the French *régime*, and as far back as 1668 official examinations of these deposits were made by order of the Government of France. The erection of a furnace was begun by a private company under very favorable arrangements with Louis XV of France in 1737, but it seems that the French Government obtained control of the work, and in 1752 the St. Maurice furnace was blown in, and the old stone stack with walloon hearth bearing the date 1752 and the insignia of France, the *fleur-de-lis*, still stands to dispute with that of Principio, in Maryland, the right to be considered the oldest in America. This quaint old furnace was in use until as late as the summer of 1883. It is worthy of note, too, that in 1775, during the American invasion of Canada, one of the lessees of this old furnace aided the Americans and actually cast shot and shell to be used by them against the city of Quebec.

The manufacture of iron is still carried on in this district. A few miles from the old St. Maurice furnace one finds at Radnor the well-equipped modern water-jacket forty- to fifty-ton furnace, the property of the Canada Iron Furnace Company, producing a very superior grade of charcoal iron. This touch of the modern world seems almost out of place in a region in which old France lives again, but, as we proceed still farther up the St. Maurice Val-

ley, the curtain is once more drawn, as it were, over the modern world.

At Lac à la Tortue, twenty-one miles from Three Rivers, we are again in the dim past. We can stand upon the shore of this lake and see a sight that might have been the o.iginal for an illustration of iron-ore gathering in Scandinavia one hundred years ago.

This Lac à la Tortue (Turtle Lake) is our curious Canadian iron mine. It is a body of water about four miles long by a mile and a quarter in average width, occupying the center of a large area of swampy land. The surrounding land is largely composed of sand formed by the wearing down of the Archæan rocks by glacial action.

It is well known that decaying vegetable matter yields acids that dissolve the oxide of iron. Evidences of this solvent action of vegetable acids on iron are frequently seen in pieces of slate. The slate is colored by iron, but frequently white or light-colored spots occur. These are points where a leaf or a fragment of bark has been deposited with the fine mud in which form the slate was deposited. The leaf or bark has decayed, the vegetable acids thus formed have dissolved the iron oxide to which the color of the slate was due, and of course a white or colorless patch is formed.

In the sandy area around Lac à la Tortue we find the most favorable conditions for the action of vegetable acids on iron oxide. The sandy land produces a rank vegetation, and its decay furnishes abundance of organic acids. These acids are in solution in the drainage waters, which on their way to the lake percolate through the sand. They thus come into contact with the iron oxide in the finely divided materials, dissolve it, and carry it along to the lake. Here a new chemical action comes into play. The solution of iron in vegetable acid (in which the iron is in what the chemist calls the form of a protosalt) is oxidized by the action of the air on the surface of the lake into a persalt, which is insoluble, and appears on the surface in patches that display the peculiar iridescence characteristic of petroleum floating on water. Indeed, not infrequently these films of peroxide of iron are incorrectly attributed to petroleum. These films become heavy by addition of new particles, they sink through the water, and in this manner, in time, a large amount of the iron ore is deposited on the lake bottom. It must not be supposed that the ore is deposited as a fine mud or sediment. On the contrary, in this lake ore, as it is called, we have an excellent illustration of what is known as concretionary action—that is, the tendency of matter when in a fine state of division to aggregate its particles into masses about some central nucleus, which may be a fragment of sunken wood, a grain of sand, or indeed a preformed small mass of itself. Precipitated in

water, as our lake ore is, it of course has great freedom of movement, and we therefore find it in flat concretions, more or less porous and circular in outline; the general appearance amply justifying the term "cake ore," which is locally applied. These concretions vary much in size, some of them being no larger than mustard seeds, others eight or ten or more inches in diameter. Frequently the larger cakes are joined together and form masses looking not unlike batches of a certain kind of bun commonly exposed in the shop window of every confectioner, and made by coiling a strip of dough round and round a piece of itself.

The ore is not found over the whole lake bottom; it occurs along the whole margin, and also well out from shore where streams enter the lake, the distance of the ore deposit from shore depending, of course, upon the volume of water carried by the streams and the velocity with which it enters the lake. Certain strips of ore occur at a considerable distance from the shore and in as much as sixteen feet of water. These deep-water, mid-lake deposits denote probably the courses of former streams which are now nonexistent, owing to some change of level.

Not only is this lake an iron mine, it is more; it is something like the widow's cruse of oil of which we read in Holy Writ—the supply is being constantly renewed. Vast amounts of iron still exist in the surrounding sands. Vegetable acids are formed from the decay of each year's vegetation, and each year the drainage carries into the lake and deposits there a large amount of iron. This is no mere theory: one can actually see the deposition of the ore along the margin, and, moreover, it is found in actual working; if a certain spot be worked out, it will in a few years again yield ore in paying quantity.

Lake ores are abundant in northern Europe,* but, so far as the writer's knowledge extends, Lac à la Tortue and a neighboring lake are the only instances of the kind in North America. The ore is extracted from our lake mine by hand and by power. The shallow margin is divided into sections and allotted to suitable parties who may desire to work them and who are paid at a specified rate per ton of ore raised. Two men generally work in company. Their implements are a shovel, a strong circular sieve, and a rough hand barrow. When work is to be begun the workmen remove shoes and stockings and use their feet in searching for ore which lies imbedded in the soft sand, nothing coarser than sand, except ore cakes, being found in the lake. Guided by their feet, the workmen put down their shovels and bring to the surface a quantity of ore and sand which they throw into their circular sieve. This is then held below the surface of the water

* Very interesting details concerning the ores are found in Percy's Metallurgy.

and made to rotate to and fro until the soft sand is washed away from the ore, which is then thrown on a scow provided for the purpose or carried to shore. When a sufficient quantity has been collected it is carted to the railway near at hand and loaded on cars.

From the deeper parts of the lake the ore is raised by means of a steam dredge. The captain of the dredge moves over the lake, and, putting down a pole and working it about on the bottom, can easily learn where there is a body of ore suitable for dredging. The dredge is then moved to the desired spot and work is begun. The ore and sand are brought up in buckets on an endless chain and thrown into a long, revolving screen, adjusted and inclined so as to deliver it upon scows moored to the dredge. In its course down the screen the mixture of ore and mud is acted upon by water which is thrown upon it with considerable force.

By this means the mud and sand are washed out of the screen and the clean ore is deposited on the scows. These are towed by a steamer to the landing at the head of the lake, and the ore is transferred to cars to be conveyed to the furnace, ten miles distant.

The plant on the lake consists of the dredge, a number of scows, and a small tug, the latter being used in moving the dredge from place to place, in towing the scows, and in carrying supplies, for the crew live on the dredge from Sunday night until Saturday night, and work overtime, in order that a year's supply of ore may be raised during the summer.

The ore obtained from this lake is essentially a brown hematite—that is, hydrated peroxide of iron, with which is associated more or less organic matter. The writer has made numerous analyses of the ore, and the following is that of a sample representing a large quantity:

Ferric oxide	70·04
Manganic oxide	1·78
Alumina	2·20
Lime	·32
Magnesia	·27
Phosphoric anhydride	·76
Sulphuric anhydride	·23
Silica	7·84
Loss on ignition	16·84
	100·28

This lake ore, mixed with carefully selected bog ore from the adjacent district and with a certain percentage of magnetic ore, is smelted with charcoal in the Canada Iron Furnace Company's furnace at Radnor, and produces a charcoal iron (brand "C. I. F.") far superior to the iron from the Lake Superior charcoal furnaces.

It brings a high price, and is largely used in the manufacture of mill rolls and car wheels. Indeed, its superior qualities are so marked that it is used by various manufacturers in the United States in cases where great strength combined with wearing and, in the higher grades, chilling quality is of first importance.

As an evidence of the splendid quality of this iron the writer gives the following extract from a letter written a short time ago by a leading American manufacturer, viz.:

"Desiring to make a casting which should combine great strength with a tough wearing surface, we have lately been experimenting with the Canada Iron Furnace Company's metal, and by using it we have raised the transverse strength of our test bars from 2,300 and 2,500 to from 3,900 to 4,000, the test being with one-inch-square bars twelve inches long. We have never been able to accomplish any such results with any other iron we have used, and in addition to this greatly increased strength we find an added toughness which makes the casting work almost like a piece of steel."

THE PSYCHOLOGY OF GENIUS.

By Dr. WILLIAM HIRSCH.

OUR knowledge of the physiology of the human body has been so much enriched by pathological facts that we may truly say that some branches of it would, as far as we can see, have remained forever closed books if the effects of disease had not been observed. So it is with psychology in its turn. Since mental disease has been systematically studied, the science of the mind has undergone a veritable revolution. Having laid down its conceptions and having learned that psychical processes, like all other phenomena of Nature, are subject to definite law, psychology has made an effort to determine the law of the mental processes of genius and to frame a definition of genius that should take into account facts which are now scientifically established. Many attempts have been made to determine what genius is, from which various conclusions have resulted, but those inquirers who have sought to penetrate to its psychological laws and to explain its phenomena upon recognized psychological principles have been obliged at last to acknowledge that they had to do with the most diverse psychological conditions which have been promiscuously labeled as genius. The question whether the popular word genius can be used as a scientific term can be decided only by a psychological analysis of those poets, painters, virtuosos, scholars, statesmen, and generals who have been generally recognized as geniuses. Famous poets, observant of their own inward condi-

tions, have often said that their works were composed as in a dream, unknown to themselves; that instead of being deliberately constructed, their ideas have, as it were, flown to them.

Involuntary thought is frequently described by the poets as unconscious. That can not be accurate, for "unconscious thought" is a contradictory phrase. Not even a dream can be said to be unconscious, whether it be purely ideal like most dreams, or produce action as in sleepwalking. In such a state self-consciousness alone is suspended, not consciousness itself. Fancy stands halfway between dreaming and active intellectual function. The latter depends directly on the will, while in the former the will is in total abeyance. All men are subject to fall under the influence of fancy. In ordinary men it makes day-dreams, which everybody recognizes to be opposed to purposive thought. All that fancy produces depends on former impressions of sense. It is powerless to create anything new; its products are mere combinations in memory of the residua of former impressions. They may be unlikely enough, and in that sense it may be true that its products are "original"; but this does not conflict with the facts alleged. It is this creative and somewhat independent power of fancy which lends to the work of art its character of originality, and hence it is that many inquirers have found in that the essence of genius.

The psychological analysis of famous poets will show that the intellectual function is no whit less important a factor of poetic genius than fancy itself, although the latter is the one immediately employed in the act of composition. We have seen that creative fancy works with the material which former impressions of sense have left behind as their remains or residua. The more comprehensive the knowledge of the poet, therefore, and the more he is in condition to assimilate and compact the impressions the world conveys to him, and the sounder and truer his judgments of persons and situations, and the more methodical his thought and the better his memory, by so much the more will his fancy display luxuriance, and so much more various will be his creations. Another psychical phenomenon, besides fancy and intellectual function, surprises us in famous poets—to wit, a refinement of the feelings, heart, and moods. We often find these qualities developed in great poets to a point we can scarcely imagine. Another trait remarkable in famous poets is an instinctive and invincible impulse to express the ideas and feelings within them. In consequence of this impulse, the work of genius is not a voluntary labor, but the involuntary product of a psychical need. It is not a hankering after applause and success, nor a regard for his other interests, which induces the man of genius to perform his task. It is solely a passion to give shape and form to the idea that ex-

ists in his fancy. The true poet does not versify because he would, but because he must. The comparison of traits applied to a considerable number of typical "men of genius" leads to the conclusion that the word does not express any one psychological concept, and that nobody has succeeded in giving a pregnant definition of the quality or is likely to do so. As insanity is equally indefinable, and it is impossible to draw a sharp line between mental sanity and mental derangement, it may seem useless to attempt to compare two such indefinite quantities; still, the comparison may possibly enrich our knowledge and lead us toward a recognition of the truth.

It is no newfangled notion that genius and insanity are connected. It has been reiterated from Plato down. The chief condition of mental sanity is a well-proportioned development of the different psychical factors. But as in the development of the different mental faculties, so also in their proportion to one another, a certain latitude of health is to be allowed. In one man fancy is preponderant; in another, consecutive thought; while a third may have particularly strong feelings as his characteristic. Yet we have no reason to say that these minds transgress the border of health. It is the difference in the relation of the different psychical elements that makes the diversity of men's characters. Now, we know that there are no two characters in the world that are precisely alike. It follows that there is no norm for these relations. The higher the grade of development of the genius and of the individual, the more prominent will differences of psychical factors become, and a correspondingly greater latitude of health must be allowed.

A comparison is instituted between the different symptoms of exaggerated proportions in development which have been discovered in great men, and an endeavor to ascertain the distinctions between these and symptoms of insanity. Among these symptoms are hallucinations, to which the soundest of men have been found more or less subject, over-exuberance of fancy, and self-abandonment in the restless strife for some ideal goal. In great artists and scholars, on the one hand, and in the insane on the other, there is a great, irresistible impulse which fills them to overflowing and makes them forget all personal considerations. But while in the former the restless compulsion to create, the hot aspiration is the kernel of the highest and noblest perfection of man, in the latter there is a morbid impulse which is usually directed to the silliest things. Formerly such a state was called a monomania, since this irresistible impulse seemed to be the only pathological symptom; but careful observation has shown that there is always a more general psychical malady, usually the consequence of arrested development. It is perfectly astonishing with what te-

nacity and untiring persistence such patients go to work. Those patients exhibit the same phenomena who may be termed inventors and Utopians. They not seldom sacrifice their means and bring themselves and their families to ruin by their unconquerable desire of making inventions and discoveries. They are fully convinced, in their folly, of the epoch-making importance of their improvements, and all pains are lost to cause them to desist from their ridiculous performances. In contrast with students, in whom the turning point of their mental action lies in the understanding, in artists moods and feelings are often the starting point of their productions. Hence we find that in them this part of the mental organ has not infrequently an enormous development. As with the other psychical characters, so likewise here we find that the high refinement of a single factor—always, however, in just proportion to the total action of the organ—produces outward phenomena having some similarity with those states which are due to disturbed inward equilibrium, and which we often have occasion to observe in the insane.

No doubt, poets and artists, as well as scholars, often exhibit an outward appearance of self-absorption and of indifference to their surroundings. This is common to them with many of the insane. But how disparate are the causes underlying these phenomena! With the weak-minded it is the want of power to concentrate the attention which renders them uninterested and indifferent to the outward world; but with poets and scholars it is, on the contrary, the high degree of that power which brings about similar phenomena. As we know, the centrifugal condition which we term attention not only extends its power to the organ of sense whose action is emphasized, but it must also be able to order off all the rest of the impressions of sense. The great thinker appears uninterested in surrounding things because his whole attention is directed to the well-ordered sequence of his logical thoughts, to which end, with fullest consciousness, the outward impressions are ordered off. The weak-minded man is present at a performance. The sounds of the words of the orator ring in his ears, but the slightest outward or inward impression suffices to make his attention wander. His thoughts ramble. They are everywhere and nowhere. The mentally gifted man, on the contrary, constantly has his mind on the matter in hand. If he wishes to concentrate his thoughts upon an outward object, nothing that takes place is able to escape him. Neither the psychologist nor the psychiatrist ought to be content to observe behavior superficially, but must trace out the motive of it in order to draw any inference from it. The most absurd conduct sometimes has reasons consistent with health, while conduct which would not surprise a layman at all may

be regarded by a psychiatrist as a well-recognized symptom of insanity.

A further explanation of many peculiarities of men of genius is to be sought in their relations to the society in which they live. A man with a reputation for high talents, distinguished from his youth for his superiority and genius, always has his circle of admirers with its proportion of flatterers. If he had the misfortune to be a precocious child, he will have been accustomed from his earliest youth to the idea that his genius is far above ordinary men and above the rules that apply to those men. If such a man is, in later years, attacked by a competent critic upon this or that point, or if schools and parties are formed unfavorable to his method, whether in art or in science, he will, of course, react otherwise than a man would do who was accustomed to opposition of every description. He will, perhaps, regard his just critic as a personal enemy; he will complain that he is misunderstood by his contemporaries, and his passion may go so far that the public at large and superficial observers among psychiatrists may consider him to be the victim of a delusion of persecution.

Peculiar inclinations and other mental idiosyncrasies of men of genius can mostly be very readily explained. Everybody accustomed psychologically to study and dissect those whom he meets, so far as opportunity is afforded, is familiar with the remark that each individual of the human race has his peculiarities, more or less odd, his "weaknesses." The ordinary man, if he has the least breeding, has been accustomed from his youth up to hold in check one inclination or another which violates the usages of society, or even perhaps of good morals. He has learned to attend sufficiently to his own conduct not to allow habits to take root which might appear unusual or be disagreeable to others. But the man of genius is far too much governed by his inward processes, his fancy, and his work to pay attention to trifling details of manner. He therefore appears what he really is, while the average man would not do this. Consequently, chance peculiarities and special inclinations appear in the former more than in the latter.

Thus it is that the behavior of great men is not to be measured by the same standard as that of others, that we have to take account of the motives of their actions, and that the psychical conditions must be kept in view if we are to draw any trustworthy inferences from their behavior. Those mighty natures must be judged from their own organization, and not from the Philistine point of view of the so-called average man.

As a further proof of the affinity of genius to insanity, it has been alleged that a great number of eminent men have actually had attacks of insanity. But the question is not whether there

have been great men who were insane, but whether the proportion of those who have at some period of their lives been attacked by insanity of different types has been markedly greater or less among famous personages than among the general run of mankind. In order to decide this, we should be in a condition to state with exactitude what the percentage of insane among the total population was at a given period of history, how many men of genius there were at that time, and how many of these were insane. Such researches must be repeated at different times of history; then, if they were irreproachably exact and sufficient, it would be possible that some sound conclusion might be reached.

There has also been an attempt to trace a connection between genius and insanity through facts of heredity. In spite of some valuable works in this department, it must be admitted that the observations hitherto adduced are still far from sufficient to have any scientific value. The fact that in several families of eminent men insanity has occurred in no wise justifies us in drawing any conclusion. In order to do that, we must, as in the former case, be in a condition to establish statistical comparisons which shall be *absolutely exact* between the proportionate occurrence of insanity in the families of men of genius and those of ordinary men. Every disinterested observer must be struck with contradictions and the inadequacy of the investigations that have been made in this field.

It is true that between famous men—the so-called geniuses—and the insane many resemblances may be traced. Nevertheless, they are, as we have seen, mere resemblances, not real affinities. Just as every symptom of mental disease has its analogue in health, so has it also an analogue in genius. But, owing to the entire mental action being higher than in average men, the states analogous to morbid symptoms here come out more markedly. Genius resembles insanity as gold resembles brass. The similarity is merely in the appearance. When we go deeper into the facts we find the two states so widely disparate that we are not justified in saying that they are allied; still less, with Moreau, that genius is a morbid condition.

Finally, let the fact be considered that most of the great men, both of art and of science, were misunderstood by their contemporaries, and were only appreciated after they were dead. In recognition of this truth, Goethe pronounces that a genius is in touch with his century only by virtue of his defects, only in so far as he shares the weaknesses of his times. The genius of the truly great man outstrips, with its great wing strokes, the rest of the flock. Those who can not keep up with him can not comprehend him. They are puzzled at first, and finally set him down as a fool. In short, they confound genius and insanity.

AFFECTIONS AND JEALOUSIES OF LIZARDS.

By M. J. DELBOEUF.

WHILE the possession of articulate language marks man as distinct from other animals, it seems certain to me that he and they are formed upon the same pattern so far as relates to sensations and feelings. This will hardly be contested as to sensations. Animals that have no eyes have of course no sensations of sight such as clear-seeing ones possess, and we have not the highly developed sense of direction of birds of passage and carrier pigeons; but these may be cultivated, and we are told that the American Indians have the sense of direction in an astonishing degree and can track their enemy as a dog does a hare. We have, it is true, some difficulty in conceiving the nature of the dog's power of scent, and it is possible that ants and bees have other senses than those we have; but these differences, marked as they may be, are at the bottom quantitative and not qualitative. Perhaps a slight modification of some part or another of the sensorial apparatus would give us sensations now strange to us.

Of the feelings, we find in all the higher animals those of love, friendship, hatred, anger, devotion, courage, suspicion, jealousy, cunning, fear, rancor, and pity. Some hens show a marked predilection for their chickens. The contrary also appears. There are stepmothers among hens, dogs, and cats. There are also feelings devious as to their object. The child adores its doll; a dog may be attached to a stick.

These various feelings are manifest also in the lower animals, as my continuous observations on my captive lizards, concerning which I have published several articles, have tended to prove.

My first two lizards had been captured, one in the Spanish Pyrenees and the other at Tarn, in France; wherefore I called them the Spanish and the French lizards, but afterward gave them the names of Pedro and Pierre. I was surprised on the very first day that I occupied myself with their education to observe the absolute contrariety of their characters and dispositions. Pierre, won over at once by the honeyed dainties I offered him, soon became accustomed to let himself be handled without trying to bite or run away, and to hide himself in my clothes, preferring the back, where it was warmer. Pedro, wild and untamable, if one tried to catch him, withdrew into a corner, and then stretching his paws in front of him, his eye glistening and his mouth wide open, hissing, springing at the hand that came near him, and, if he bit it, holding firmly and causing the blood to flow, revealed a resolution that even impressed the young men in my laboratory.

I made a cage for the lizards of iron wire, open above, and, having a large room in my country house into which the sun shone all day on three sides, I put them in it. Pierre soon learned to leave his cage, to climb up to the windows by some rags I had hung to them, and passed from one to another, following the sun. In the evening he returned to the cage. Pedro, more stupid, tried vainly to get out of his prison, and, when I put him on the ledge of a window in the sun, let himself be overtaken by the shade, persisted for hours in efforts to get through the glass, and finally went to sleep where he had been left. Pierre, always in motion and investigating, discovered an old mattress in the room that had a hole in the cover, and took a liking to the hole. The mattress was put where it could not be reached except over a bridge of cords connecting it with the cage. Pierre, always expert, learned very soon to pass over this bridge to his hiding place. Pedro never could understand what the cords were good for, and his love of comfort never carried him to the point of finding the luxurious mattress. More recently Pierre, when at Liége, found a hole in the lining of a thick *portière* curtain, of which he became acquainted with the most minute folds and turns, and when he is there there is no means of getting him away.

The physiognomies of the two correspond with their characters. Pierre's eye is black, mild, intelligent, and scrutinizing. In Pedro's, the pupil, surrounded with a golden yellow circle, reflects distrust, hostility, and ferocity. It took six months to tame Pedro, and it was quite two years before he ceased to show his fierce temper when I came upon him too abruptly.

Pierre and Pedro lived on the best of terms with one another. At Liége they slept side by side, often interlocked. Pedro was fond of following Pierre in his wanderings and escapades. One day Pierre was lost. He had got out of my desk, had gone down several steps of the stairway, and had slipped in under the carpet, where he was casually found about three weeks afterward. During the whole time of his disappearance Pedro refused all food, and had no relish for insects and earthworms, till Pierre was restored to him. Seeing him so melancholy, I made an appeal to all my friends in the south of France to get me a new companion for him. M. H. Dineur, an engineer of Prades, sent me a lizard, October 1, 1891, three months after Pierre had been found. From that day on a great change was noticed. I had not learned the sex of my animals, but I observed now that they were both males, while the new one was a female. Pedro conceived a great antipathy for Pierre, which became more evident every day. Between the pursuits and bitings he suffered from Pedro, Pierre led a martyr's life till I was obliged to make a separate cage for him, and when Pierre was let out for an airing Pedro had to be shut up.

Both, however, became very familiar with me, but Pedro more than Pierre. They would run to me, when I called them, from one end of the room to the other; but I had to hold out a meal worm for bait to bring Pierre, while Pedro would come when my hands were empty. This was not because he was stupid, for when he saw that I had no worm, and I drew back, he would follow me like a dog, and would climb upon me when I stretched out my leg.

M. Dineur sent me the next year several lizards at different times, all of which were received with an ill grace. Among them was a much larger one than Pedro, which he disliked along with the others. One day this lizard took Pedro up and gave him a good shaking, after which Pedro was very cautious in his annoyances, and would run away the instant the other turned toward him.

One lizard was respected by Pedro. It had been sent me from Algeria by M. Forel, of Zurich, of a species we had not been able to identify—a tree liver, small but even fiercer than Pedro, and quite untamable. After devouring one fine specimen and half eating another, it became a marked terror to all the other members of the collection. Only one of my lizards was fond of gentles; the others spit them out as soon as they had tasted them. As we may say of a company of men, "So many heads, so many minds," so we might say, with a little variation, of my pets, "So many lizards, so many dispositions."

Several of my lizards have died; Pedro, a few months ago, of a disease that first affected the eyes, after having been with me five years. Pierre is still living with me, but has long had a tumor on his leg, has lost his tail once by my fault and twice by his own, and no longer likes honey, but shakes his head with an air of disgust when it is put upon his nose—a fact that shows that the taste of lizards, too, may change with the years.

As to the longevity of lizards: I do not think I am much mistaken when I suppose that they may live twenty or thirty years, or even longer. As they advance in years the plates of the head, smooth when they are young, show wrinkles and cavities which become more marked and numerous. Those with me have not grown much, and though I weighed them often—usually about once a month—the results were too irregular to permit of any conclusions being drawn from them. The weight of the larger lizards varied to the extent of thirty grammes, according as they were well or sparingly fed. Pierre now weighs one hundred and six grammes, another one one hundred and twenty-eight grammes, and another thirty-eight grammes—weights which are evidently proportional to the cubes of their lengths; but, according to my figures, they have not gained any in five years. I conclude from this that many years must have passed before the larger ones attained the weight they have.

The bifid extremity of their tongues, soft and always moist, is most probably an organ delicate to touch and probably to taste. They never cease to project it forward on to all the things within their reach, and although accustomed to meal worms, they begin generally by feeling them—at least the first one—in this way before taking them. The whip-tails (*Uromastix*) do the same, and when set down in the grass test all the flowers with their tongue. I should observe further that these animals did not hibernate with me, and that they were as lively and active in winter as in summer. The same may be said of two jerboas which I kept in captivity for three years and a half. Hibernation, therefore, does not seem to be a physiological necessity, but to be rather a natural effect of the cold, like the depression of the thermometer. The lizards were very fond of keeping themselves in front of the registers.

I now come to a trait which on reflection appears to me to be characteristic in the highest degree. Jealousy is a feeling not less natural to animals than to us. The males compete in strength, beauty, or talent to conquer the females. Beasts of prey, from spiders to lions and eagles, enforce respect of their hunting grounds. All defend their bed, their burrow, or their nest; and probably, too, herbivorous animals living in herds do not permit other herds to trespass upon their pastures. The jealousy of the dog is well known; if he is left alone, he will eat the part of the cat, and even rob the pigs of their messes. I have kept two jerboas for three years, all very familiar. Every evening we give each of them an almond, which they come and take out of the hand, and even ask for. But hardly has one received hers than, without paying any more attention to us, the other pursues her, takes it away from her, and a struggle ensues—a struggle which is otherwise courteous. The same play is acted when dandelions are given to them; hardly has one detached a leaf when the other tries to snatch it from her.

My lizards did not vary from the general rule. The best worm was always the one that a comrade had. If it was long, we might witness such a steeplechase as is seen sometimes in poultry yards.

Pedro was jealous of my preference and caresses. When he was on my sleeve, I could keep him for hours motionless by passing my hand lightly along his body; but if I took Pierre or another lizard up, his rage broke out at once, and he would jump upon him with his mouth menacingly wide open. If, however, I chose the large lizard, he gradually drew back, as if regretfully, without leaving me. Now, what good do caresses do to a lizard? Dogs and cats, they tell us, are delighted with them. But these animals, when they were young, were caressed by their mothers, who licked, bit, and amused them, and it is not strange

that they should find in our cajolery a kind of recollection of motherly tenderness. They play together, embrace one another, and press against one another. The man who plays with them is like a companion of a little more respectable species, and that is all. In menageries, monkeys, bears, lions, tigers, and hyenas indulge in caresses to the point that some animals seek them and provoke them. But lizards, with their scaly skin, unaccustomed to embracing, feeling, and licking, hatched in the sun! My Pedro therefore presented a deviation of the feeling of jealousy. We not rarely see parrots that like to be stroked on the neck or the head. I once accustomed a vulture in the zoölogical garden of Ghent to pass his head out between the bars of his cage in order to have it held and caressed. My friend Prof. Gilkinet tamed a wild rabbit till it became as familiar as a dog, and learned to like the hand that stroked it. All these creatures have known the pleasures of the nest and of maternal contact. But again, a lizard? I suppose that when cuddled between my handkerchief and my hand, it felt in that kind of moist and easy cavity a renewal of the pleasure of the days when it was free, and had a secure refuge in the shelter of the leaves against a burning sun. On the other hand, when another lizard comes, it displays envy or anger as if it were threatened with dislodgment. Is it that? It alone can tell what is passing in its darkened psychic sensibility, for man can not penetrate the animal mind. But could he penetrate the human soul if he had not language; can he penetrate the soul of one whose language he is not acquainted with? If we met a savage in the midst of a virgin forest, should we be better able to divine his intentions than we should those of an alligator?

Does it not result from these observations that, aside from the faculty of abstract, artificial, and conventional language, which seems up to this time to be the exclusive appanage of man, there is no clearly marked difference in general feelings between man and his lower brethren? Or rather, as I have ventured to say on another occasion, I ask if there may not appear in each animal species from time to time scamps, individuals inclined to rapine and murder, like my lizard Ben Youssouf, or simple, uneasy creatures like Pedro?

Furthermore, these minute observations, which may seem puerile in the eyes of many, help to establish the psychological transition from man to animals placed much lower in the zoölogical scale than lizards. In this aspect, they may be considered an humble contribution in support of transformism.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

SKETCH OF GEORGE BROWN GOODE.

THE United States has had no more assiduous working naturalist than Dr. G. Brown Goode; and few if any of them have contributed as much as he to the development and increase of the resources of our country. He was also one of the world's greatest museum administrators, and an anthropologist of most comprehensive views.

GEORGE BROWN GOODE was born in New Albany, Indiana, February 13, 1851, and died in Washington, D. C., September 6, 1896. While he was still a boy his parents removed to the State of New York. He cultivated the taste for natural history, which he manifested early, and it found food and encouragement in the Reports of the Smithsonian Institution, which formed part of the family library, and which he was accustomed to read. As a student in Wesleyan University, whence he was graduated in 1870, he was marked by his predilection for natural-history studies and the interest he took in museum methods. After graduation he entered Harvard University as a graduate student, and enjoyed the teaching of Agassiz. On the erection of Orange Judd Hall at Wesleyan University, he was invited by the faculty of that institution to arrange the collections in natural history. He performed the work with a skill and discrimination that marked him as specially adapted for it, and had, no doubt, great influence in deciding his future career. His first contribution to scientific literature was a note published in the American Naturalist in 1871, recording the occurrence of the billfish in fresh water in the Connecticut River; and his first paper exhibiting range of investigation and power to collate facts was one showing that snakes do actually receive their young within themselves by swallowing them, on the appearance of danger, to let them out again when the danger is past. For the purpose of this inquiry he sought evidence through an advertisement in the American Agriculturist, asking for the communication of observations on the subject. He had become interested in the work of the United States Fish Commission, and meeting Prof. Baird at the meeting of the American Association in Portland, Me., in 1873, was invited by him to become a member of its staff. In that capacity he was for several years a member of the commission's summer parties. He also became connected with the National Museum as assistant curator, and served it for a time without other compensation than duplicate specimens, and these he turned over at once to the museum in Orange Judd Hall. He was named in a short time assistant director of the museum, and in 1887 assistant secretary of the Smithsonian Institution in charge of the National Museum,

the position which he still held at the time of his death. On the death of Prof. Baird, he became for a short time Commissioner of Fish and Fisheries. This appointment, Science observed at the time, "meets at once the requirements of an exacting office and the exceptional provision of the law creating it. Prof. Goode is intimately acquainted with the methods of Commissioner Baird, whose scientific zeal and knowledge he shared, and his experience and attainments in practical fish culture and in the science of ichthyology made him first among those whose qualifications the President has been called upon to consider." The law, however, gave no salary for this office, and during the few months Dr. Goode held it he performed the duties of two offices for the pay of one. In time the law was amended, the office of Fish Commissioner was made independent of the National Museum, and Dr. Goode was relieved by the appointment of Marshall McDonald to it.

Most of Prof. Goode's contributions to science were made during his connection with the National Museum, and for information concerning them we are largely indebted to the admirable summaries published by Dr. Marcus Benjamin and Mr. Theodore Gill in Science. In 1876 he published in the Bulletin of the United States Museum a Catalogue of the Fishes of the Bermudas, and the Classification of the Collection to illustrate the Animal Resources of the United States; which latter work was expanded three years afterward into the Catalogue of the Collection to illustrate the Animal Resources and the Fisheries of the United States, a volume nearly three times as large, prepared with reference to the Smithsonian exhibit in the Centennial. He published numerous monographs, many of them in collaboration with Dr. Tarleton Bean, chiefly descriptive of new species of fishes, and some dealing with special groups, of which perhaps the most important was that on the menhaden, first published in the Report of the Fish Commission, and afterward as a separate work. In connection with the tenth census, of 1880, Dr. Goode had charge of the work relating to fish and fisheries; and of the five sections of the seven large quarto volumes comprising the report on that subject he himself mainly prepared Section I, on the Natural History of Aquatic Animals. It covered more than nine hundred pages of text, and was illustrated by two hundred and seventy-seven plates. "This book was intended to reflect as exhaustive an investigation of the subject as possible. The scheme drawn up by Dr. Goode embraced the natural history of marine products; accounts of the fishing grounds, the fishermen and fishing towns, apparatus and modes of capture; preparation, care, and manufacture of fishing products; and economy of the fisheries. For the purposes of the studies necessary to its

preparation, the coast, lakes, etc., of the country were mapped off into twenty-four districts, each of which was assigned to a field assistant. "This work," says Mr. Gill, "was by far the most complete survey of the economical fishes of the country that had ever appeared, and has since been the most prized. It led to another." This other was American Fishes; a Popular Treatise upon the Game and Food Fishes of North America, with Especial Reference to Habits and Modes of Capture. This volume was prepared, the author said in his prologue, for "the use of the angler, the lover of Nature, and the general reader." It was not intended for naturalists, and the technicalities of zoölogical description were therefore avoided. Prof. Goode's plan, in selecting from the seventeen hundred and fifty species of fish indigenous to our waters those to be described in the book, was to include every North American fish which was likely to be of interest to the general reader, either on account of its genuineness or its economical uses. The physical features of each fish were described, its range and season were marked, its habits in regard to feeding, migration, and breeding were delineated, and something was told about the method of capturing it and its value as food; but it contained "no discussions of rods, reels, lines, hooks, and flies, and no instructions concerning camping out, excursions, routes, guides, and hotels." Mingled with these facts were information about the different names of fishes in different places, exciting fishing adventures, and excursions into the literature of the subject.

In the meantime Dr. Goode had (1879–1881) prepared the text for a work on the game fishes of the United States, intended to accompany twenty large folio colored plates by S. A. Kilbourne. The collections made by the Fish Commission and the steamers Blake, Albatross, and Fish Hawk were carefully studied by Dr. Goode and Dr. Bean, and the fruits of their labor were put forth in a book in two volumes, with one hundred and twenty-three plates, on Oceanic Ichthyology, a Treatise on the Pelagic and Deep-sea Fishes of the World, which came from the press only about two weeks before Dr. Goode's death. In 1880 Dr. Goode published the story of The First Decade of the United States Fish Commission: its Plan of Work and Accomplished Results, Scientific and Economical. The same subject was presented in a paper read before the American Association at its Boston meeting, 1880, the aim of which was declared to be to show, in a general way, what the commission had done, was doing, and expected to do—"its purposes, methods, and results." In 1881 he published Epochs in the History of Fish Culture, and in 1882 an encyclopædic article on The Fisheries of the World. He was author of the article on Pisciculture in the Encyclopædia Britannica, an admirable

presentation, in four pages, of the necessity of special measures for preserving fish and preventing their destruction, and of putting into practice the art of breeding them, with the history of the art and its present condition, in which the part taken by the United States in the fish-cultural enterprises is fully set forth. He had almost completed an elaborate memoir on the distribution of abyssalian fishes, in which he recognized for them a number of different faunal areas—a thing which no previous student of them had done. He had been engaged for some time previous to his death in the preparation of a Half-Century Book of the Smithsonian Institution which he had projected. He contemplated a complete Bibliography of Ichthyology, to include the names of all genera and species published as new, and had collected the materials for it. In this department he completed as part of a series of Bibliographies of American Naturalists, those of Spencer F. Baird (1883) and of Charles Gérard (1891), and one not yet published, but printed, of Philip Lutley Sclater, Secretary of the Zoölogical Society of London and a distinguished ornithologist. A sketch of the life and work of this naturalist, published in Science for September 4, 1896, is, so far as at present appears, his last published article. Other articles, only partly showing the broader range of Dr. Goode's interests, are his two addresses before the Biological Society of Washington, in 1886 and 1887, on The Beginnings of Natural History in America, in which his "diligence in the collection of data and skill in presenting them are well exemplified"; a paper on The Origin of the National Scientific and Educational Institutions of the United States, contributed to the American Historical Association in 1890, in which a connected view is given of the growth of such institutions from their beginning in the attempt of Mr. Boyle, Bishop Wilkins, and others, to establish in the colony of Connecticut a society for promoting knowledge; a paper on Museum History and Museums of History, read before the American Historical Association, in which is included a statement of the author's ideas of what a museum should contain, what purposes it should be intended to serve, and how it should be arranged and managed; and an address before the American Philosophical Society on the one hundredth anniversary of the death of Benjamin Franklin, on that great American's Literary Labors, in which he showed that Franklin never wrote for literary fame, but only for the good he might do by disseminating his thoughts and suggestions. Prof. Goode's contributions to ichthyology, in the Reports of the Fish Commission, Harper's Weekly said in 1887, "are not all of a purely scientific, but for a large part of a practical character. The most thorough and exhaustive researches ever made by any one about a special fish is that on the menhaden, due to Prof. Goode, and is a model

of clearness, of industry displayed in collecting the facts, and of practical usefulness. Material furnished by him for the study of the swordfish is of equal value. In connection with Captain Collins, R. E. Earl, and A. Howard Clark, a life history of the mackerel was prepared, which remains to-day one of the completest of treatises on one of the most valuable of American fishes. Prof. Goode's notes on the life history of the eel have settled all questions in regard to the peculiar habits of this fish."

It was Dr. Goode's lot, by virtue of his skill in museum organization, to bear a prominent part in the arrangement and installation of the exhibits of the United States in the various international and general exhibitions which were held during his active career. He was thus associated with the Smithsonian exhibits at the Centennial Exhibition in Philadelphia in 1876; at the Fisheries Exhibitions in Berlin in 1880 and London in 1883; at New Orleans, Cincinnati, and Louisville; at the Chicago Columbian Exhibition in 1893; at the Columbian Historical Exhibition in Madrid, Spain, in 1892–'93; and at the Atlanta Cotton States Exhibition. In recognition of his services at the Madrid Exhibition he received the Order of Isabella the Catholic, with the grade of commander.

Next to being a zoölogist and particularly an ichthyologist, Dr. Goode was perhaps most eminently an anthropologist. Mr. Gill observes that his catalogues embraced the outlines of a system of anthropological science; and Prof. Otis T. Mason, in a sketch of him in the American Anthropologist, says that in his system of museum classification he insisted that all the sciences of every kind are essentially anthropological. The earth was to be regarded as man's abode, and was studied by him as such, both in its astronomical relations and its geological aspects. In the same way physiographic studies were regarded by him "as leading up to a knowledge of the earth's surface, as ministering to life, and especially to the health and happiness of man"; and meteorological apparatus and phenomena, geographical explorations and voyages, technographic resources, physics, mechanics, chemistry, botany, zoölogy, etc., were all regarded by him predominantly as they bore upon man's life and welfare. "Beyond the material resources of the earth and the forces by which they are regulated and shaped lay in Dr. Goode's scheme the special human industries devoted to the exploration of the earth, the elaboration of materials, the transportation and exchange of productions, and their utilization as well as their enjoyments. From the foregoing studies Dr. Goode's comprehensive plan led up to the social relations of mankind in their material manifestations, then to the intellectual co-operations of mankind as manifested in the arts, sciences, and philosophies, terminating with education,

reform, and climaxes of human achievement. This great anthropological syllabus of all knowledge Dr. Goode used as the modulus of his own thoughts and a plan by which he arranged his books, his pictures, his clippings from newspapers, useful facts gathered here and there, and everything of a material nature which he desired to preserve."

He was interested in botany and versed in it, making the study of the flowers one of the attractions of his excursions; an earnest student of all matters pertaining to American history, a delver in genealogy from his boyhood, author of a work on his family history, and one of the editors of the Wesleyan University Alumni Record; one of the founders of the American Historical Association and a member of the Southern Historical Society; was interested in patriotic societies, and an officer of those of the Sons of the Revolution and Colonial Wars. He was a founder of several scientific societies in Washington and a member of others in this country; was a past president of the Philosophical Society and the Biological Society of Washington; was elected a member of the National Academy of Sciences in 1888; had been chosen in the American Association to be vice-president for the Section of Zoölogy at its meeting of 1897; and was a member of the Zoölogical Society of London.

Great as were Dr. Goode's scientific attainments and achievements, his friends and biographers are most emphatic in their testimonials to his personal attractiveness. Prof. S. P. Langley, whose associate he was in the Smithsonian Institution for many years, says, in the memorial he contributed to Science: "I have never known a more perfectly true, sincere, and loyal character than Dr. Goode's; or a man who with a better judgment of other men or greater ability in molding their purposes to his own, used these powers to such uniformly disinterested ends, so that he could maintain the discipline of a great establishment like the National Museum, while retaining the personal affection of every subordinate. . . . His historical powers in grouping incidents and events were akin to genius. His genealogical writings showed wide and accurate research, while his literary faculty displayed itself with singular charm in some of his minor writings. But how futile these words seem to be in describing a man of whom perhaps the best, after all, to be said is that he was not only trusted but beloved by all with an affection that men rarely win from one another!"

Mr. Gill says: "His disposition was a bright and sunny one, and he ingratiated himself in the affections of his friends in a marked degree. . . . But in spite of his gentleness, firmness and vigor in action became manifest when occasion called for them."

Prof. Mason says: "It would be difficult to find among those who are professional anthropologists a man who had a more exalted idea of what this science ought to be. . . . In addition to this comprehensive and appreciative view of anthropology, Dr. Goode was among the foremost scholars in the line of his own studies, and the bibliography of his works fills many pages of manuscript. He was, in addition to this, a good man, with a gentle, affectionate spirit, a lovely family life, a patriotic heart, and a singular devotion to the interest of the public. He never lost sight of the fact that Mr. Smithson's bequest was not only for the 'increase of knowledge' to glorify discovery, but for the 'diffusion of knowledge' to bless all mankind."

The memorial resolutions of the Biological Section of the New York Academy of Sciences, after referring fittingly to his scientific work, add that "those of us who had the good fortune to know Prof. Goode personally recall his genial interest in the work of others, his true scientific spirit. We have thus lost one of our ablest fellow-workers and one of the truest and best of men."

THE interest in schools of all grades in the South, from the common school to the university, is represented by President Julius D. Dreher, of Roanoke College, in a paper read before the American Social Science Association, as steadily growing. "The increase in the enrollment of eager pupils in public schools is a proof of that active interest. An additional proof is found in the fact that colleges and seminaries are attended by an increasing number of young men and women who practice self-denial or profit by the sacrifices of anxious parents, in order that their higher educational advantages may be enjoyed." Even the tendency to multiply higher institutions of learning is still further evidence of this general interest. Notwithstanding all that has been said, it must not be forgotten that under many adverse circumstances the Southern people have done a tremendous work since the war in providing schools for the masses and in building and strengthening institutions of higher education. They might have been wiser in their plans and more judicious in some respects in spending their money, but no people ever projected educational institutions in the midst of more inauspicious surroundings, and that, too, with the consciousness that a race, recently in slavery and hence able to contribute almost nothing in taxes, was to share equally with themselves in the schools supported at public expense. What has been done against so many odds may be regarded as the sure promise of greater advance in the future.

A STRANGE tale of a shepherd dog caring for a cat is told by a correspondent of *La Nature*. The cat was neglected, and the dog perceived that it was suffering from hunger. He was accustomed to go to a neighboring house where he was usually given delicacies from the table. One day the people of the house, answering a sound at the door, found the dog waiting there with the cat firmly settled on his back. Food was given the cat, and its escort rested while it ate. For three days the dog brought the cat thus; then the cat came afoot, but the dog was always with it.

Editor's Table.

ANXIOUS ORTHODOXY.

WE are all familiar with the troubles of the hen that, having hatched duck's eggs, sees with dismay her foster progeny betaking themselves to the water. Very similar, it seems to us, is the distress of mind which ecclesiastical authorities now and then display over the evident determination of the modern world to betake itself to the truths of science rather than to the dogmas of theology. From the ecclesiastical point of view the latter constitute *terra firma*; the former are nothing but a heaving sea of uncertainty—a treacherous element which threatens to ingulf all who trust themselves to it.

A conspicuous exhibition of this state of mind is furnished by an article in the Church Standard of Philadelphia from the pen of the Right Reverend Hugh Miller Thompson, D.D., LL.D., Episcopal Bishop of Mississippi. "The scientists," it appears from Bishop Thompson's article, have been professing that, in certain cases of hopeless disease, a period should mercifully be put at once to life and to suffering. This is perfectly terrible. It is true Bishop Thompson does not tell us who the scientists are who have made this inhuman proposition; but that is all the better, as the odium can thus be spread evenly over all of them. Neither does he give the exact terms of the proposition; and that again is all the better, as it enables him to expand and vary it at will—to give us such versions of it, for example, as the following: "When a man's father becomes toothless and childish, the son will lovingly give him the happy dispatch, and enter on possession of his estates. When the mother becomes feeble and old, the loving daughter, with her own gentle hands, will drop into the spoon and carry to the lips that kissed her baby face the precious dose that will put the dear old soul out of the way of troubling her longer." In a word, the right reverend bishop has a good time of it banging away at "the scientists" through a four-column article made up almost wholly of just such inconsequent verbiage as we have quoted.

The broad fact which writers of this class all seek to ignore is that it is precisely since science began to be a power in the world that there has been the most notable improvement in the manners and morals of mankind. The bishop tells us that, "if man be a development from the primeval slime, an improved oyster or ape," he fails to see "where there is any room to talk about the sacredness of human life." It seems to us that, far more important than *talking* about the sacredness of human life, is it to treat human life as sacred; and if the bishop will pretend that there is any comparison between the *practice* of the present day in this respect and that, say, of the eighteenth, seventeenth, and sixteenth centuries, not to go further back, we shall be very much surprised. What science, or, in other words, the progress of knowledge, does is to give the human mind scope and verge for the exercise of its faculties; and it is this enlarged intellectual activity which leads to the improvement of life in general. If it is impossible to-day to read any history of past ages without shuddering at the butcheries and cruelties

which form so large a part of the record, it is not because those ages were not in possession of a well-established and firmly believed theology; it is not because any modern scientific views had arisen to weaken the sense of the sacredness of human life. It was simply and purely because a very inferior degree of sacredness—all theoretical reasons to the contrary notwithstanding—was in reality attached to human life. Men's minds had not then been expanded and enlarged, nor had their sympathies been quickened, as they have been since knowledge began to grow by leaps and bounds. Certain theological doctrines, moreover, which then universally prevailed, had a direct tendency to deaden sympathy and pervert all natural standards of right and wrong; we refer especially to that conception of hell which was the fundamental motive of all persecutions for heresy and witchcraft. The sum of human misery which must be attributed to this one cause baffles calculation. On the other hand, no fact in history is more overwhelmingly attested than that an increase in humanity has accompanied, and continues to accompany, a relaxation of the rigors of theological belief.

In that whimsical book, The Green Carnation, there is a parson introduced who, on the word science being mentioned, immediately remarks, "Indeed, I have no opinion of science." Our bishop, however, is not content with having "no opinion of science"; he goes further and has "no opinion," or, to be more accurate, a shockingly bad opinion, of Nature. Let us listen to this episcopal teacher: "There is *nothing* sacred in Nature. Certainly she treats life with very scant reverence, be it vegetable or animal. Nature's forces ruthlessly trample out and trample down life in all its forms. She is the bloodiest handed of all murderers. She ravens in beak and claw." A little while ago it was Prof. James who was describing Nature as a harlot; to-day the Bishop of Mississippi finds that the most appropriate epithet he can bestow on it is "the bloodiest-handed of all murderers." What says Matthew Arnold?

> "And patiently exact,
> This universal God,
> Alike to any act,
> Proceeds at any nod,
> And quietly declaims the curses of himself."

The Harvard professor curses in the interest of his pessimism; the divine, in the interest of his theology; and neither seems in the least alive to the humor of the situation. While they curse, the sun shines and the wind blows, the great processes of Nature go on, and the drama of human destiny develops itself just as if there was no such thing in the world as a pessimistic professor or a damnatory divine. Nature does not ask any one to admire or belaud her. She has given, or the power behind her has given, to countless tribes a share in what we call life. She guarantees nothing save the permanence of law; but she has set in operation certain principles of development which, in the case of man, have carried him, under favoring circumstances, to a high degree of eminence over the rest of the creation. Man thus finds himself possessed of self-consciousness and the power of adapting means to ends, of reading the secrets of Nature, and greatly increasing his resources for happiness and progress. At what point in man's evolution from "the primeval slime" which the bishop so dislikes to think about—though the scriptural "dust" would only require a little moistening to make a fair article of slime—at what point, we say, of man's evolution the social

instincts began to emerge it is not necessary to determine. It is enough to know that they did emerge, and that, having emerged, they became capable of doing as much for his moral and emotional nature as the recognition of law, which also emerged at a given moment, was capable of doing for his intellectual nature. To-day, in moral and intellectual man—in other words, in the higher types of the human race—the world begins to have a worthy tenant and master, one in whose eyes a "splendid purpose" may be read—the purpose of governing wisely and justly and mercifully the heritage into possession of which he has come.

The practical question then is just this: whether because the bishop's theology is not enjoying quite as much prestige as it did of old, and because the emancipated human spirit is seeking knowledge everywhere, even in regard to matters which the bishop thinks ought to be accepted as authoritatively settled, there is any reason to apprehend that the bonds of society and of the family are going to be loosed, that the humane instincts, which for generations have been gaining in strength, are going to fall into decay, and that man, under the influence of scientific teachings, is destined to become a mere cunning compound of cruelty and self-indulgence. Well, for our part, we don't believe it; there is nothing in past history to render such a result probable, everything to render it improbable. What the most distant future may have in store for our race, we know not; but of this we feel persuaded, that the future which lies immediately before us will be an era of greater justice, of greater humanity, and at the same time of greater intellectual liberty, than any the world has yet seen. All the signs point that way.

"GROWING ILLITERACY."

WHERE? Why, here, in these United States, and in that most favored portion of them which sends its youths to Eastern colleges and universities. But who talks of "growing illiteracy"?—surely some very ill-informed individual who does not know what splendid work our public schools are doing. By no means; but we may as well, without further ado, explain the matter.

For a good while past the colleges and universities of the country have been finding it harder and harder to put up with the very inferior preparation, particularly as regards knowledge of the English language, of the youths who go up from the secondary schools for matriculation. Harvard is in open rebellion against the annoyance; and a committee of the Overseers lately made the suggestion that it would be a good thing to print the papers of these ill-taught youths, and give the names of the schools from which they had come. At this the principals of a number of the leading schools took alarm; and it was in the protest which they published that the ominous words we have quoted appeared. "While we regret," they say, "the growing illiteracy of American boys, we can not feel that the schools should be held solely responsible for the evils, which are chiefly due to the absence of literary interest and of literary standards in the community." In other words, there is a growing illiteracy among boys, because, broadly speaking, illiteracy has taken possession of the country. The parents of the boys — who themselves had the benefit of public-school training—have, for the most part, no literary interests and recognize no literary standards. These high-school principals ought to know whereof they affirm; we do not know who

would be in a position to gauge the acquirements of American boys, and the domestic influences which have guided their development, if not they.

If the universities, by bringing pressure to bear on the secondary schools, can do anything to remedy this state of things they certainly should do it. If the principals are right, however, the outlook is not hopeful. Our own impression is that they are right, and that there is throughout the country a growing indifference to correct speech and a growing lack of appreciation of the higher uses to which language can be put. The testimony of the principals is enforced by that of a Western teacher, who writes to The Nation to explain the peculiar difficulties under which the schools labor as regards the teaching of English. The pupils, he says, have, *out of school*, been studying English for fifteen or sixteen years before they reach the high school. "They suppose themselves to be entirely competent, their habits of expression are fixed, and no two of them are alike. . . . The home, the very cheap newspaper, the street, have furnished them with their common speech; and, although the first may sometimes be all that can be desired, very often the balance of power belongs to the others. . . . Under favorable circumstances the teacher of composition is allowed forty-five minutes a day, for three years, in which, besides teaching something of the history of literature, he is to counteract influences that have fifteen years the start of him, and fifteen times as great present opportunity. The only remarkable thing is that, under such circumstances, he accomplishes anything at all."

The important thing is to have a right understanding of the situation, and the remarks we have just quoted are very much to the point. Large masses of people are apt to be rebellious in matters of grammar, and, in general, indifferent to established laws of speech. Language which they use for everyday purposes is, in their opinion, "good enough" if it serves those purposes. It is the coin of thought, and so long as it passes current they are satisfied, however clipped or debased it may be. There are no great literary monuments in the background, as it were, of the national consciousness which tend to keep language to a classic form. There is nothing, for example, which exercises at all the same influence upon us as a people as the Homeric poems and the works of the great dramatists—but particularly the Homeric poems—did upon the ancient Greeks. Even if we had any works which stood in something like the same relation to our national life, the printing press has made it unnecessary for us to enrich or burden (as we may consider it) our memories with any portions of such literature. When books were scarce, people had to make books of their minds, but in these days of public libraries no such drudgery as that is necessary; we want our minds for other things.

How powerless the public school is to hold the nation together in the matter of speech is proved by nothing more than by the fact that an ever-increasing number of novels and tales of domestic production are written in "dialect." Occasionally we witness learned and most academic discussions as to whether a particular writer has got the "dialect" of a particular region in perfect shape. Poets of considerable note have labored to give currency to very degraded forms of speech. Children are encouraged to slur their words by having the conversation of other children who do likewise served up to them in story books. Public-school teachers themselves in many

cases give evidence in their speech that all the scholastic training to which they have been subjected has not sufficed to counterbalance the influence of their everyday surroundings: they will recite a rule of grammar and violate it in the same breath.

Now, we do not belong to the school of those who think that the ultimate appeal in all questions of language must be to the usage of the past, and who contend for the standard forms of speech as a man might for "the faith once delivered to the saints." We agree rather with a great historian and admirable writer, Sir Francis Palgrave, who says that few have done so much harm to literature as "the martinets of language"; adding that "whenever the era arrives in which artificial rules for style or language are accurately laid down and painfully obeyed, then literature is approaching her climacteric." We agree, too, with the more ancient author of The Art of Poetry, who says in effect that happy experiments in enriching a language, at one time with words recovered from antiquity and at another with new and expressive words struggling for recognition, are always in order. It is one thing, however, to do as Palgrave advises, and set the expression of thought and feeling above the mere observation of artificial rules; it is another to disregard all rules through simple indolence and lack of idealism—lack of respect for the vehicle of thought. It is one thing to do as Horace advises and strive to strengthen and enrich the speech we use, and another to throw the door open to every vulgar invention and conceit of the hour.

We can not better define the evil with which we have to contend than by describing it (in words just used) as a total "lack of idealism" in the use of language. Considering that articulate and significant speech forms the great line of distinction between man and the brutes, considering the infinite riches of thought and feeling, the treasures of experience, the varied presentments of human life that are stored up in language, it would not seem excessive if something of reverence toward language considered as an exalted power and prerogative of the human mind were imparted to the young and made through education a common possession of all normal human beings in a civilized state. That, however, would appear to be, in any broad sense, past hoping for. But what the many pass by with indifference, if not contempt, the few may if they like appropriate. The question which some at least ought to consider is whether there are not great and solid advantages connected with an accurate knowledge and practical mastery of the English language. Of course, we believe very strongly that there are, and it would not be difficult to discuss these advantages at length under the three heads of intellectual, moral, and æsthetic. Accuracy and precision of speech means, or at least tends strongly toward, accuracy and precision of thought. Many persons have but little distinct consciousness of the words they use, and to try to hold them to any precise meaning is hopeless. The way to remedy such defect of thought is through careful and strenuous drill in the verbal expression of thought—such drill as language studies properly conducted will bestow—aided by scientific drill in the observation of facts. To what extent mental dishonesty is favored by vagueness and indefiniteness of speech it is almost needless to observe. Taking finally the æsthetic view, if any value is set upon distinction of mind, upon purity of taste, upon sensibility to the harmonies of which language is capable, and sympathy with all the nobler

phases of human thought and emotion which literature records, how are these to be secured and developed save through a careful cultivation of the language sense?

It might not be impossible, we think, through a proper setting forth of this aspect of the case, if not to stem the rising tide of illiteracy, to engage the interests and the sentiments of a respectable minority in favor of such a study of the English language and its literature as should confer the benefits we have mentioned. The word culture has been much abused, but it has a meaning with which we can not dispense; and, as an instrument of culture—of genuine emancipation and elevation of mind—there is no line of study which we can place before that which raises a mind fairly to the level of a great language and a great literature.

Scientific Literature.

SPECIAL BOOKS.

THE query that Prof. *Trowbridge* takes as the title of his recent book is one of the most difficult to give a direct answer to that have been propounded to modern science.* The answer given in this volume presents electricity to the adult reader from a much different point of view than was afforded by the treatise of his school or college days—say, ten to thirty years ago. Our author has designed his book to give a popular presentation of Maxwell's theory of the electro-magnetic origin of light and heat, for he holds that by studying the transformations of energy involved in this theory we can obtain the best idea of what electricity is. The plan of the volume is to treat in successive chapters the leading phases of the subject as illustrated by important processes or pieces of apparatus. In the short chapter on measurements in electricity he shows that gravitation is used to measure all our electrical manifestations, and then passes to a discussion of the nature of gravitation itself. In dealing with magnetism he quotes the expressions of Franklin and his contemporary, Prof. Winthrop, on this subject, and some of Count Rumford's views on the transformation of energy—a subject that bears a fundamental relation to the modern science of electricity. Passing to later times, he shows that it is to considerations of the nature of the surrounding medium that we owe the chief advances in our knowledge of magnetism. His account of the dynamo machine begins with a comparison of Faraday's galvanometer with one of the present day. This is followed by a description of the construction of a simple piece of apparatus by means of which the essential features of the dynamo can be explained. Subjects of other chapters are: Alternating Currents, Transmission of Power by Electricity, The Leyden Jar, Step-up Transformers, The Electro-magnetic Theory of Light and the Ether, The X Rays, and The Sun. The book is popular but not elementary. The treatment is everywhere philosophical, though by this we are far from meaning

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* What is Electricity? By John Trowbridge, S. D. International Scientific Series, vol. lxxv. New York: D. Appleton & Co. Pp. 315, 12mo. Price, $1.50.

metaphysical. Technological applications appear only by way of illustration. The volume contains some fifty diagrams and a frontispiece plate.

For an elementary and thoroughly popular account of electrical phenomena the reader should go to the Library of Useful Stories. We feel safe in saying that every electrical contrivance known to the general public is described and explained in the little book by Mr. *Munro*.* The chapters on applications of electricity are preceded by accounts of the apparatus and processes employed in the several modes of generating the electric force. Throughout the volume is enough of history and anecdote to justify the title of "Story," and enough of fundamental principles to base an intelligent acquaintance with the phenomena of this branch of science upon. Where the history of discoveries and inventions is being told, the reader should remember that the author is English, and has a full share of the amusing insular notion that everything worth mentioning was done first by an Englishman. In the matter of terminology the book has been edited so as to make it conform to American usage; some changes have been made in the cuts also, and new matter has been added to the same end. There are a hundred illustrations and an adequate index.

It is a little startling to see a renowned chemist described in the title of a biography as "Poet and Philosopher."† Davy, however, was certainly occupied with "natural philosophy," and the designation of poet is far from misapplied. The pleasing character of the Century Science Series is admirably maintained by the attractive life-history of him that Dr. Thorpe has prepared. Of the talents that characterized Davy's adult life the first to be manifested in his boyhood was his poetic faculty. His best school exercises, we are told, were his translations into English verse, and he was often called upon by his schoolmates to write valentines and similar effusions for them. Later it was undoubtedly the vivid imagery and sympathetic mode of expression derived from this faculty which made his popular lectures the salvation of the Royal Institution before that establishment had his brilliant discoveries to lean upon. Our author evidently has assumed that his readers wish to know about Davy's scientific career, and this thread runs unbroken throughout the volume. At the same time the human side of the man is shown in references to his fondness for angling, his devotion to his mother, his friendship with Coleridge, Maria Edgeworth, and other persons of intellect, the incidents of his marriage, and the characteristics of his disposition. Davy's last important discovery, the principle of the miner's safety lamp, as well as his first, the anæsthetic property of laughing gas, have a practical value that easily commands popular appreciation, while his isolation of the metals of the alkalies, his demonstration of the elementary character of chlorine, and his researches on iodine give him a permanently high rank among chemists. Dr. Thorpe has relied largely upon the memoirs of Dr. Paris and of Dr. John Davy, brother of Sir Humphry, carefully weighing one against the other where they disagree, and he has had much other material in the form of letters, journals,

* The Story of Electricity. By John Munro. New York: D. Appleton & Co. Pp. 187, 16mo. Price, 40 cents.

† Humphry Davy, Poet and Philosopher. By T. E. Thorpe, LL. D., F. R. S. New York: The Macmillan Company. Pp. 240, 12mo. Price, $1.25.

and memoirs of contemporaries, records of societies, pamphlets of the time, etc.

At the age when the child comes under the care of the teacher some of his mental faculties are already well advanced on the path of development. One must go back of this age in order to get a full understanding of the way in which his mind unfolds. Prof. *Compayré* goes back to the moment of birth,* and even quotes inferences of several observers as to the psychology of prenatal existence. There is a good deal of physiology in the chapter on the newborn child and in that on movements, the first forms of activity. From the pains that the author takes with fundamental considerations one would almost think he was a German instead of a Frenchman. He sums up the history of the child's motions as "irresistible, blind, fatal impulses at the start; then, little by little, conscious desires, thoughtless, but lit up by an intellectual representation, by the idea of an end to be attained; finally, will and efforts." The statement of the child's muscular needs given in this book ought to convince any reader of the cruelty of enforcing the command to "sit still" upon young children. Prof. Compayré next considers the development of sight, showing that the child is half blind at birth, and only gradually gains the full use of his eyes. The author (or translator) is rather too literal in interpreting photophobia as "fear" of light, and the same inaccuracy is observable in other writers on this subject. The newborn child has no real *fear* of light; the proper term is *intolerance of light*. The other senses are also rudimentary at birth, that of touch being best developed. In discussing the emotions our author affirms that the pleasures early exceed the pains in the child's experience. The natural modes of expressing the feelings can be readily observed in children, who do not restrain such manifestations. Prof. Compayré finds the first evidences of memory in the nursling's recognition of familiar faces. The acquirement of language, which itself depends upon a certain development of the memory, he regards as greatly quickening the further growth of this faculty. The imagination, consciousness, attention, and association of ideas are described in the two remaining chapters of this volume. The concluding part of the work will deal with reasoning, learning to talk, the development of the moral sense, and related topics.

GENERAL NOTICES.

THIS book will be the first complete illustrated botany published in this country.† Its aim is to represent and describe every species, from the ferns upward, mentioned as distinct by botanists and growing wild within the area adopted. It is intended, also, to complete the work within such moderate limits of size and cost as shall make it accessible to the public generally, so that it may serve as an independent handbook of our Northern flora, and as a work of general reference, or as an adjunct and supplement to the manuals of systematic botany in current use. The utility of a completely illustrated manual, both to the botanist and to the non-expert, is apparent. The most minute and accurate description may leave a doubt which the comparison of pictures of the species will solve. Persons who are not familiar with botanical terms and the methods of botan-

* The Intellectual and Moral Development of the Child. Part I. By Gabriel Compayré. International Education Series, vol. xxxv. New York: D. Appleton & Co. Pp. 298, 12mo. Price, $1.50.

† An Illustrated Flora of the Northern United States and Canada and the British Possessions. By Nathaniel Lord Britton, Ph. D., and Hon. Addison Brown. In 3 vols. Vol. I. New York: Charles Scribner's Sons. Pp. 612. Price, $6.

ical analysis may find in the illustrations a ready means for the identification of the plants that grow around them, and through the accompanying descriptions they will at the same time acquire a familiarity with botanical language. The enterprise of preparing this work was projected by Judge Brown, who is President of the Torrey Botanical Club, and has been diligently prosecuted for six years under the supervision of Dr. Britton, and, as to the text, mainly by him; while the work in all its parts has been carefully revised by both authors. The latest matured results of botanical studies, here and in Europe, have been availed of for the work, so as to bring it fully abreast of the knowledge and scientific conceptions of the time, and make it answer present needs. The area treated of has been so liberally defined as practically to include the entire flora of the northern portion of the Great Plains. Most of the arctic plants are also included, for there are only a few of them which may not be found within the limits prescribed for the work. The figures are all from original drawings for this book, either from fresh plants or from herbarium specimens. All have been first drawn of natural size from medium-sized specimens and afterward reduced to a proportion which is indicated. Hence they do not suffer from the use of a magnifier, but are rather improved by it. The systematic arrangement has been revised so as to correspond as nearly as may be with the order of nature as now understood—as an order of evolution from the more simple to the more complex—and the sequence of families adopted by Engler and Prantl has been closely followed. The nomenclature is according to the code devised by the Paris Botanical Congress in 1867, as modified by the rules adopted by the Botanical Club of the American Association. English names are given as far as possible, but, in the confusion that exists in respect to these, great exercise of judgment in selection has been called for.

In the *Social Forces in German Literature*,* Dr. *Kuno Francke*, of Harvard University, attempts to define what seem to him the essential features of German literature from the point of view of the student of civilization rather than from that of the linguistic scholar or literary critic. By his studies and various influences he has been led to look at the substance rather than the form of literature, to see in it primarily the working of popular forces, to consider it chiefly as an expression of national culture. His effort is to supply what seems to be a decided need of a book which, based upon an original study of the sources, should give a coherent account of the great intellectual movements of German life as expressed in literature, and point out the mutual relation of action and reaction between these movements and social and political conditions. To his view all literary development is determined by the incessant conflict between the tendency toward personal freedom and the tendency toward collective organization. The subject is considered under this view in connection with the period of the migrations, from the fifth to the ninth century; with the growth of mediæval hierarchy and feudalism, the height of chivalric culture, the rise of the middle classes, the era of the Reformation, and the several epochs since, whose characteristics have been reflected in literary development; the whole constituting an admirable and instructive study of this phase of the history of civilization.

A very useful little book on *How to Feed Children* * has recently come to us from Mrs. *Louise E. Hogan*. The framework for the book consisted of a number of magazine articles that have appeared during the last two years in various journals. The author's aim has been to offer in a practical form a few suggestions concerning the application of the principles of dietetics to feeding in the nursery and throughout the period of childhood. All the material can of course be found in technical manuals in a much more extended form, and there is no claim of originality; but an attempt has been made to select the most important and general rules, and to present and apply them in a simple and practical way. While the close relations between physiology and dietetics are generally

* Social Forces in German Literature. By Kuno Francke, Ph. D. New York: Henry Holt & Co. Pp. 556. Price, $2 net.

* How to Feed Children. By Louise E. Hogan. Pp. 236, 12mo. Philadelphia: J. B. Lippincott Co. Price, $1.

recognized, very little account is usually taken of them in cooking, and the worst results from their non-observance naturally occur among children whose digestive tract is less able to deal with unsuitable material. The first six chapters deal with the proper food for infants, and its preparation. Laxative foods are given a chapter. Nursery diet, fat in food, diet in illness, and diet for school children are all chapters of special interest. There are about twenty pages of receipts, as well as a good index, appended.

An Inductive Manual of the Straight Line and the Circle, by *William J. Meyers*, has arisen through the difficulty which the author has found in dealing with his own classes in geometry by the ordinary method, which is a purely deductive one. He believes that the inductive method will yield as extensive and exact a knowledge in the same length of time, a much greater readiness in the application of the knowledge obtained, and a more thorough "training of the imagination, invention, and judgment." Instead of a series of written proofs to memorize, such as, for instance, the sum of the three angles of a triangle is equal to two right angles, the student takes the triangle, and, with suggestions from the teacher where necessary, works out the various relations between its sides and angles for himself. The method seems a great improvement on that usually adopted. (The author, Fort Collins, Col.)

Nature Study, by *W. S. Jackman*, was written, says the author, for the purpose of aiding the elementary teacher in imparting this very important branch of knowledge to the younger pupils. The close relation between Nature study and the other subjects in the common-school course, and a few of the more general and essential facts and laws of natural science, are chiefly dwelt on. The book is accompanied by a series of charts, bound separately, which present "a conspectus of selected work in Nature study for each month of the entire year." (The author, Chicago, 85 cents.)

The second series of *Life Histories of North American Birds*—Special Bulletin No. 3 of the United States National Museum—by *Charles Bendire*, relates to the parrots, cuckoos, anis, trogons, kingfishers, woodpeckers, goatsuckers, etc.; swifts, hummingbirds, cotingas, tyrant flycatchers, larks, crows, jays, magpies, starlings, blackbirds, orioles, and grackles; while the former series (Bulletin No. 1) included the gallinaceous birds, pigeons, doves, and birds of prey. The descriptions have especial reference to the breeding habits and eggs of the birds, and are based on the collections in the museum. The classification of the American Ornithologists' Union has been followed. The seven plates contain more than two hundred representations of eggs, reproduced by chromolithography from original water-color drawings. We are informed that the oölogical collection of the museum has been increased by the acquisition by gift of the collection of seven thousand specimens of Dr. William L. Ralph, of Utica, N. Y. We hope the collections of all the ornithologists will be completed soon, and that the rest of the eggs may be allowed to become birds. The very first sentence of the first description in this book tells a story that should make all collectors pause. It is that the range of the bird in question—the only representative of its family in the United States—is yearly becoming more and more restricted.

The *Sixteenth Report of the United States Geological Survey*, the first issued under the direction of Mr. Charles D. Walcott, appears in four large, handsome volumes. From the report of the director in the first volume we learn that he has not made any radical changes in either the policy or *personnel* of the survey. Such modifications as have been made are intended to bring his bureau more in touch with some of the economic and educational interests of the country. They include improving the quality of the topographic maps and marking the subdivision lines and the township and section corners on those of States containing public lands; placing the entire topographic force within the classified civil service; obtaining authority from Congress to print and sell topographic maps with text for educational purposes; enlarging the Divisions of Hydrography and of Mineral Resources; and the making of reconnaissance surveys of regions supposed to contain important economic resources, in order to obtain in-

formation which, under the ordinary plan of awaiting a complete survey of the region, would be delayed for years. Following this report are papers on The Dinosaurs of North America, by O. C. Marsh; Glacier Bay and its Glaciers, by H. F. Reid; Some Analogies in the Lower Cretaceous of Europe and America, by L. F. Ward; Structural Details in the Green Mountain Region and in Eastern New York, by T. N. Dale; and one of three hundred pages on Principles of Pre-Cambrian North American Geology, by C. R. Van Hise. All of these are adequately illustrated, that of Prof. Marsh having eighty-five plates. The second volume is devoted to papers of an economic character, an account of the Geology and Mining Industries of the Cripple Creek District, Colorado, having first place. The general geology of the district is set forth by Whitman Cross in considerable detail. The plan followed involves giving the character of the various rock formations, the evidences of action by the ancient Cripple Creek volcano, and descriptions of the rocks forming each of the hills in the camp and vicinity. R. A. F. Penrose, Jr., describes the mining geology of the district, telling what ores are met with, how they occur, and the way in which they were deposited. He also gives detailed descriptions of the ore deposits of the various hills and gulches, and frequently describes the veins followed by individual mines. Prof. N. S. Shaler contributes a paper on the Geology of the Road-building Stones of Massachusetts, giving the results of tests made on a considerable variety of stones, with some discussion of the value of the different kinds under various practical conditions. The Economic Geology of the Mercur Mining District, Utah, is treated by J. E. Spurr. There are two monographs bearing on irrigation: The Public Lands and their Water Supply, by Frederick H. Newell, and Water Resources of a Portion of the Great Plains, by Robert Hay. The former of these papers tells the character of the remaining public lands and in what States they are located, and gives the available sources of water in each State. The latter gives the results of an investigation on a strip of country lying along the eastern boundary of Colorado, this district being chosen as typical of the Great Plains region. The volume is adequately illustrated with maps, diagrams, photographic views, etc. The report on the Mineral Resources of the United States, with which the name of David T. Day has been for many years identified, appears for 1894 in a new form. It constitutes the third and fourth of the royal octavo volumes of the general Report of the Survey. Mr. Day has utilized the greatly increased space allowed him by producing a much more valuable work in his field than ever before. Iron is the first of the minerals to be considered, and in addition to the statistics for the United States there is an account of the production of iron ores in various parts of the world, by John Birkinbine, and a statement of the operations of the iron and steel industries in all countries, by James M. Swank. Other metals are treated by various specialists or by the editor. The second of Mr. Day's volumes is devoted to non-metallic products. Here the account of coal production, by Edward P. Parker, has first place. The manufacture of coke and the production of petroleum and natural gas are presented by Joseph D. Weeks. William C. Day tells of the year's operations in the stone industry, Heinrich Ries contributes an account of the technology of the clay industry, while minor products are treated by various hands. The first appearance of monazite in these reports is made the occasion for a historical and chemical account of the substance by H. B. C. Nitze. This is the mineral used in making incandescent mantles for gas-burners.

The idea that it is well to become acquainted with the beings that they are to do their professional work upon has now taken firm hold upon the teachers of this country. They are absorbing the many books on the psychology of children that are offered to them and demanding other treatises on special topics not yet fully or clearly dealt with. A volume that undertakes the inconspicuous but fundamental task of supplying facts from which the characteristics of children may be learned is the collection of *Child Observations* made by students of the State Normal School at Worcester, Mass., and edited by Miss *Ellen M. Haskell* (Heath, $1.50). The twelve hundred examples of children's doings here presented are purposely confined

to Imitation and Allied Activities. The design of the book is fully explained in an introduction contributed by Mr. E. H. Russell, principal of the normal school. "The records," he says, "make no scientific pretensions whatever. They are printed in response to many requests and with the hope of awakening or quickening interest in children simply as children, not as pupils or as 'material' for psychological or anthropological study." Mr. Russell calls attention to the evidence in these observations of the interest with which children repeat their imitative acts, this interest being sustained by their vivid fancy. Their spontaneous activity—muscular and mental—is another notable characteristic that he mentions. He also gives a caution against too much seeking for uniformity in children. A second volume, embracing another class of these observations, will be forthcoming if the demand should appear to warrant it.

The recent political campaign was remarkably productive of books which have more than an ephemeral interest. Among these is *The Monetary and Banking Problem*, by *Logan G. McPherson* (Appletons, $1), consisting of three articles contributed to this magazine early in 1896, with additional chapters on bimetallism and on the standard of value. Mr. McPherson maintains that, while gold and silver were suitable for money in past conditions of the world's trade, they are very crude instruments for our present commerce. The use of both together is made impracticable by natural laws unless one is subsidiary to the other. They are being steadily superseded by paper representatives of value, and the author looks forward to the adoption of a new unit which shall be not a specified weight of metal but a quantity of human effort. The reasons for the position taken by him are clearly stated, and the problem which still confronts the United States in spite of the verdict of the recent election is discussed practically and understandingly.

Believers in the gold standard will regard as pertinent to the times the new edition of *Fiat Money Inflation in France*, by *Andrew D. White* (Appletons, paper, 25 cents), which was one of the books of the recent campaign. Doubtless many persons will devote some of their leisure this winter to a further study of monetary questions, and to them this bit of history can not fail to be instructive. The present issue contains an extract from Macaulay on effects of cheap coinage, and an introduction showing the resemblance of the scheme tried by France to that proposed for the United States.

The volume of *Proceedings of the Indiana Academy of Sciences* just issued contains about three hundred pages and a number of plates. Among the more notable articles are Call's Revision of the Parvus Group of Unionidæ, Everman and Scovell's Fishes of the Missouri River Basin, and Investigations concerning the Redfish. The notable feature of the Biological Survey Reports is the series of reports on Turkey Lake. This, the largest inland lake of Indiana, has been chosen as the seat of the Indiana University Biological Station. The lake is being studied as a unit of environment with the variation of its inhabitants. The scope of the report as indicated by the titles is about as follows: Report on the physical features; hydrographic map, with contours for every ten feet of depth; temperatures; the inhabitants, by Eigenmann, Ridgley, Kellicott, Birge, Hay, Call, Atkinson, Reddick, and Chamberlain; methods of studying variation, by Eigenmann; and the variation of *Etheostoma caprodes*, by Moenkhaus.

The instructor who has had for several years a large class of beginners in organic chemistry knows how much of his time is required to initiate his neophytes into the new kind of laboratory work that they are taking up. He will not need to be told the value of a book that could give the necessary directions clearly, briefly, and without the omission of any essential caution or qualification. Such a book Dr. *Ludwig Gattermann* aimed to produce in his *Practical Methods of Organic Chemistry*, and with so much success that a translation into English has seemed warranted (Macmillan, $1.60). Dr. Gattermann describes first such general operations as crystallization, simple distillation, distillation with steam, etc., not omitting the drying and cleaning of vessels. In this general part are included qualitative tests and the quantitative determination of carbon, hydrogen, nitrogen, sulphur, and the

halogens. Passing to special preparations, the author gives directions for thirteen reactions in the aliphatic series, forty-two in the aromatic, and one example each with a substance in the pyridine and quinoline series. Directions for preparing a few inorganic reagents are also given. The attention of the student is called to the significance of each reaction described, so that his knowledge shall be something more than empirical. The volume is illustrated with eighty-two cuts of apparatus.

"I sometimes wonder whuther it's bein' good thet makes some folks infidils, er whuther it's bein' infidils thet makes some folks so good," remarks one of the characters in *The Reason Why*, and in the association of these ideas strikes the keynote of the story. In his preface the author, *Ernest E. Russell*, says, "There was a time when such a story as I have tried to write would have helped me," and in an unquestionably genuine desire to help others he makes his story a vehicle for the reasons that lead many thoughtful men and women to reject the Christian religion. These reasons are quite fully stated, chapters and parts of chapters being devoted to the inherent probability or improbability of the Scriptures, the action of early councils of the Church in forming the canon and the creeds, the Arian "heresy," the Nestorian "heresy," the return to Augustine in the Reformation, miracles, possession by evil spirits, and kindred topics. Several minor matters are touched upon in passing, such as the beneficial influence of industry, the wreck of happiness likely to follow the marriage of persons having opposite religious beliefs when one has the proselyting spirit, the rightfulness of doing to a human being what we regard as an act of mercy to a brute, namely, shortening the suffering that precedes death, etc. The thread of story is sufficient to give coherence to the book, while the characters, who are country people of a generation ago and educated young persons of rural origin, are excellently portrayed. Thoughtful persons who have drifted away from early religious teaching will enjoy and profit by *The Reason Why*. (The author, 13 Astor Place, New York.)

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Fragments of Science.

Education and Industrial Prosperity.—For several years past there has been a growing appreciation of the close relation between the general educational system of a country and its industrial prosperity. The striking advance in the latter respect which has occurred in Germany, and the perfection of her universities and mechanical schools, have formed a valuable object lesson, which, although surprisingly slow in doing its work, seems at last to have awakened English scientists and economists to the pressing need for action. For a number of years large sums have been spent annually in providing technical schools in England, but they have apparently had little effect in helping her to retain the commercial supremacy of which she had for so many years been the possessor. Mr. William's book, "Made in Germany," seems to have started the discussion anew, and Prof. William Ramsay has recently published an article, apparently suggested by Dr. Ostwald's letter in the Times (describing the methods of instruction in physics and chemistry in German universities), in which he attempts to locate the cause of the failure of the English school system. In Prof. Ramsay's opinion, it is the English university which is at fault, and more especially its examination system. He says: "In Germany, as shown by Prof. Ostwald, little importance is attached to examinations. The student, after spending a year and a half or two years in mastering the general aspects of his subject, proceeds to carry out some research. . . . During all this time he is not pestered with having to prepare for periodical examinations, requiring the rapid assimilation of a sufficient number of facts to enable him to pass. Even at the end of his career the examination is considered of secondary importance. . . . The result of this freedom from mental worry is that the student is able to imbibe that spirit of love of knowledge for its own sake, and that enthusiasm for its advancement, which lie at the base of all true progress in science. From among such students the German manufacturers are drawn. . . . In England we have no such incentive to a university career. . . . The aim of most of our students is a degree, and the degree is awarded on the results of frequent examinations." This latter state of mind can obvious-

ly have but one result in the great majority of cases, namely, that of making the knowledge gained simply the means of obtaining a degree, and not an end in itself—a something to be used and then thrown aside and forgotten. The absolute inability of most students to make any practical application of their college learning, or to see the connection and interdependence between its various branches, is a clear indication of the light in which they regard it. The same conditions which prevail in the English schools are even more pronounced in the United States, and while Prof. Ramsay's *causa vera* is only part of the story, his article as well as Dr. Ostwald's letter deserves the thoughtful attention of our educators and economists, for, while we have no commercial supremacy to lose, we have, what is perhaps more important, one to gain.

Prospective Railway Routes in Africa.—In describing, before the Geographical Section of the British Association, the probable railroad routes in Africa, Major Leonard Darwin, president of the section, mentioned the routes up the Nile and into parts of the central Soudan as among the most important. In the Nile route, the river itself would afford a large part of the medium of communication; but the region of the cataracts, covering several hundred miles, would have to be spanned by a railway connecting the lower river with Berber. Above Berber is a navigable waterway at high Nile for fourteen hundred miles to the Fels rapids, besides between four hundred and six hundred miles on the Blue Nile and the Bahr-el-Gazal. There is, perhaps, only one other place in Africa where an equal expenditure would open up such a large tract of country as between Suakim and Berber. Two routes for railways from the coast to the Victoria Nyanza have been proposed, one running through the British and the other through the German sphere of influence. The German route would be the shorter of the two; but there is some reason to think that the British line will open up more country east of the lake which will be suitable for prolonged residence by white men. A line from the south end of Lake Tanganyika to the northern end of Lake Nyassa and thence to the coast would open up a vast extent of territory, and would, especially if eventually connected with the Victoria Nyanza, be more valuable than any other line in Africa in putting an end to the slave trade. On the west coast, the Congo points to the most important line of communication. After a hundred and fifty miles of navigable waterway we come to two hundred miles of rapids, along which a hundred and seventeen miles of rails are already laid. Then, on entering Stanley Pool there are, according to the Belgian estimates, seven thousand miles of waterway. If all the representations are correct, there is no place in all Africa where two hundred miles of railway may be expected to produce such marked results. Another region of great promise is that of the Niger, but the political conditions of the country—it lying on the border land between the Mohammedan and the pagan tribes—make the early execution of railways somewhat problematical. Formidable mountain ranges being few, the chief impediments to railway construction in Africa are the drifting sands, wide tracts of rocky country, the dampness of the forest causing rapid decay of material, and the deadly nature of the climate.

The Evolution of Aseptic Surgery.—A part of the presidential address of Sir Joseph Lister at the British Association was devoted to the story of the development of the author's system of aseptic treatment of wounds. It began with the publication of the results of Pasteur's researches on fermentation, by which it was proved that putrefaction was not produced by any chemical action of the atmosphere, but by germs. Sir Joseph then sought for some substance that would prevent the development of germs in the bodily tissues without harming the tissues themselves, and found it in carbolic acid. Diluted with water, this substance when applied quickly transferred itself to the tissues and attacked the germs. In cases to which the watery solution was not adapted, or where it was too irritating, a solution in some organic substance, not parting with the carbolic acid so readily, was found to be bland and unirritating, and served as a reliable store of the antiseptic. While continuing his experiments in confirmation of Pasteur's theory, Sir Joseph found that blood drawn with antiseptic precautions into sterilized vessels might remain free from microbes for an in-

definite time, even when exposed to the access of air or with ordinary water added to it. He even found that if very putrid blood was largely diluted with sterilized water, so as to diffuse its microbes widely and wash them clean of their acrid products, a drop of such dilution added to pure blood might leave it unchanged for days at the temperature of the body, although a trace of the septic liquid undiluted caused intense putrefaction within twenty-four hours. Hence he was led to conclude that it was the grosser forms of septic mischief, rather than microbes in the attenuated condition in which they exist in the atmosphere, that were to be dreaded in surgical practice. He hinted to the London Medical Congress in 1881 that it might turn out possible to disregard the atmospheric dust altogether, but did not venture to practice upon the hint till 1890, when he brought forward, at the Berlin Congress, what he believed to be absolute demonstration of the harmlessness of atmospheric dust in surgical operations. "This conclusion has been justified by subsequent experience. The irritation of the wound by antiseptic irrigation and washing may therefore now be avoided, and Nature left quite undisturbed to carry out her best methods of repair, while the surgeon may conduct his operations as simply as in former days, provided always that, deeply impressed with the tremendous importance of his object, and inspiring the same conviction in all his assistants, he vigilantly maintains from first to last, with a care that, once learned, becomes instinctive, but for the want of which nothing else can compensate, the use of the simple means which will suffice to exclude from the wound the coarser forms of septic impurity."

The Iron Age in Aboriginal Art.—Prof. O. T. Mason has been led, from his studies of aboriginal art, to attach great importance to the influence on the native American mind of the iron age, which he defines in the American Anthropologist as "the conservative folk age, the middle age as distinguished from the Renaissance, which replaced the old in progressive Europe." It is almost impossible, Prof. Mason says, for one looking over a collection of *Americana*, "to decide positively whether he is regarding the unadulterated Western hemisphere, or mediæval Europe, or native Africa, or some happy combination of these. In the New World during four centuries, as in the Old World, the activities, the whole life, of the native people were partly such as belong to a common humanity, such as arise through a partnership and co-operation between any group of human beings and their environment, and such as came to them from foreign lands living in the iron age of Europe. . . . There is hardly a tribe on this continent that has never heard of iron; there are tribes of Americans that preserve only a vestige of native life. Even the archæologist is often in doubt regarding buried specimens. Shell heaps, mounds, caves, and cemeteries often hide iron-made products among the goodly stuff, exciting a reasonable doubt concerning the probable authorship of the works themselves."

Value of Horseless Vehicles.—In a paper in the British Association, Mr. A. R. Sennett traced the history of mechanical locomotion from the sixteenth century, when horseless vehicles were run by means of springs, touched upon the automotors of succeeding centuries, cited the instance of a light wind-propelled vehicle which made the journey between Bristol and London in the early part of this century, and led up to the self-propelled vehicles of the present day. He pointed out that horseless locomotion on the European continent was looked upon more from the point of view of sport than of adaptation to transport in commercial and industrial operations. The author predicated, however, that we should enter upon the subject in a far more serious manner. Notwithstanding the immense mileage of railroads in England (and in the United States, too, we may add), a considerable proportion of the mileage of good common roads is represented by roads connecting towns situated at a considerable distance from railway stations. Such towns and outlying stations could be far more efficiently served by judiciously organized systems of horseless road locomotives than ever could be done by the most elaborate system of light railways. Whether we took the case of the heavy and slow haulage of the farmer and the team owner, or the light and rapid delivery required by the tradesman, we should find that

economy is upon the side of mechanical propulsion. Horseless vehicles were believed to compare favorably in point of cost and depreciation with horse vehicles.

The Work of Physical Chemistry.—Prof. William A. Noyes, as Vice-President for the Chemical Section of the American Association, opened his section with a very interesting and suggestive review and forecast of the achievements of physical chemistry. Though the progress of this branch seems slow in comparison with what we may conceive as ultimately possible, notable advance has been made through the efforts of the numerous investigators who have been industriously working in it. Light has been cast upon many problems, and it is now possible to predict phenomena of which the operator could formerly have knowledge only by experiment. The older methods have given place to mathematical determinations, and new regions of investigation have been opened to chemists. We have still before us, however, the vast task of learning how to save and utilize the immense proportion of the power—far exceeding that which is saved—which now goes to waste in all our operations. To make good as large a part as possible of that which is now lost should be the object of future work in physical chemistry.

A Woman among African Cannibals.—Miss Kingsley, who returned to England in the fall of 1895, after a journey of nearly a year in the Cameroons, collecting fishes, relates stories of thrilling adventures, particularly among the Fangwe cannibals living between the Ogowe and Rembwe Rivers. These people are always at war with one another, and are one of the few tribes in Africa that eat their own dead. As her little band of three Fangwe "elephant men" and four Djuma men approached each Fangwe town, it was found to be in a state of defense, and the leader of the band invariably fell into some trap which the inhabitants had laid outside the town for the enemy. At almost every town the Fangwe stopped the expedition and wanted to eat the Fangwe elephant men, who were of a hostile section. Miss Kingsley had guaranteed the elephant men safety, and sometimes by persuasion, sometimes by threats of punishment, and sometimes by a little present, they were saved. Not one burial place was found in the country, but pieces of human bodies are kept in most of the native mud huts just as civilized people keep eatables in their larders. The Adjumas, on the other hand, bury their dead in the forest. Miss Kingsley climbed the Cameroons Peak, 13,700 feet high. At an altitude near 10,000 feet, she came across the great crater. There are about seventy craters in the Cameroons Mountains, and from the largest of these the peak shoots up almost perpendicularly on the sea side; hence it has to be reached from the other side. Inland from the Cameroons the Rumbi Mountains are inhabited up to about 7,000 feet, and Miss Kingsley found shelter in native huts. In the higher ascent she had to sleep on the ground in the open air, and was frequently drenched by the heavy rains, but suffered no injury to health thereby. In the canoe journey up the Ogowe, the craft was upset and its occupants thrown into the water nearly a dozen times. Miss Kingsley had several narrow escapes, and was saved more than once by clutching the rocks in the rapids and holding on to them till the natives righted the canoe.

Drifting Fruits.—For nearly three hundred years a curious fruit has been found drifting along the coasts of the West Indies, concerning the origin and nature of which nothing could be determined. It was first noticed, described, and pictured by Clusius in the *Exoticorum libri decem* in 1605. The next reference to it was by Johannes Jonston, in his Latin history of trees and fruits, in 1662. It was noticed again in 1680, and thence down to 1764, after which it does not seem to have been mentioned till 1884, when Mr. D. Morris collected specimens of it near Kingston, Jamaica; and in 1887 a specimen was picked up on the shore of Bigborough Bay, in the south of England. In March, 1889, it was identified by Mr. J. H. Hart, Superintendent of the Botanic Gardens at Trinidad, as the fruit of *Sacoglottis amazonica*, or, locally, *cojon de burro*, a tree very rare in Trinidad, but more abundant in the delta of the Amazon. From one or both of these localities, says Mr. Morris, who describes the fruit and gives its history in Na-

ture. "The fruits are carried by the waters of the Gulf Stream into the Caribbean Sea, and either thrown ashore on the West Indian Islands or carried still farther, as in the case of many other similar fruits, across the North Atlantic and cast on the shores of western Europe." Of these other similar fruits, Mr. Morris mentions the *Laodicea* of the Seychelles—known as *coco de mer*—which was first found floating; the "sea apples" or "sea cocoanut"—fruits of the Bursu palm—which drift in the West Indian seas; the large brown beans of the Cocoon, or *Entada scandens*, which are cast ashore in various parts of the world; and a specimen of *Cæsalpinia bonduc*.

An Experiment in Irrigation.—The results of experiments in irrigation of garden crops are given by Prof. Byron D. Halsted in the report of the Botanical Department of the New Jersey Agricultural Experiment Station. The water was applied in the latter part of the season, and therefore only to the later crops; to the second crop of golden wax bean, and to pepper, turnips, egg plant, and celery. The yield of beans from similar plots was as 17 pounds and 1 ounce not irrigated to 45 pounds irrigated; of peppers, 717 fruits to 1,277 fruits. The peppers from the unirrigated belt, moreover, filled only six and a half peach baskets, with a total weight of 80 pounds, while those from the irrigated belt filled eleven and a quarter like baskets, with a total weight of 147 pounds. Further, the irrigated peppers were plumper and better colored and of far superior quality and brought much more in the market. In the plants themselves the leaves of the unirrigated belts looked wilted and limp, while those of the irrigated plants stood up fresh and strong. Irrigation prolonged the season of fruitage and the frosts caught the plants still blooming and bearing fruits in all stages of growth. With egg plants and tomatoes the experiments were made too late for the most satisfactory results. Those crops want midsummer rather than autumn irrigation. Irrigation of turnips caused vigorous growth of the plants, but increased the tendency to club. Better effects may be expected in land free from the club-root fungus. The crop of celery was increased in the irrigated rows to two and a half times that upon the rows not receiving the water. In marketable product, in pounds, the difference was three to one, and in marketable value about eight to one in favor of irrigation.

Significance of Morphological Botany.—The problem of morphological botany was characterized by Dr. D. H. Scott, of Kew Gardens, in his sectional address at the British Association, as a purely histological one, and perfectly distinct from any of the questions with which physiology has to do. Yet there is a close relation between these two branches of biology, at any rate to those who maintain the Darwinian position, for from that point of view we see that all the characters which the morphologist has to compare are, or have been, adaptive. Hence, it is impossible for the morphologist to ignore the functions of those organs of which he is studying the homologies. There is no essential difference between adaptive and morphological characters, but the physiologist is interested in the question how organs work; the morphologist asks, What is their history? The origin of the great groups of plants is perhaps an insoluble problem, but all that can be directly observed or experimented upon is the occurrence of variations. Such investigations can but throw a side light on the historical question of the origin of the existing orders of living things, and the morphologist must use other methods of research. In judging of the affinities of fossil plants vegetative characters must be made use of, and especially characters drawn from anatomical structure. In many specimens the anatomical features are the only ones known, and in cases where the reproductive structures have been discovered the conclusions drawn from anatomical characters have been confirmed. The study of fossil botany is thus likely to call attention to points of structure formerly passed over. Anatomical characters are being made use of in the classification of the higher plants, and thus an effort is being made to place the classification on a broader basis. They are undeniably adaptive, but it is a mistake to suppose that they are necessarily the expression of recent adaptations; on the contrary, there are examples of marked peculiarities which have become the property of large groups of plants. A given anatomi-

cal character may be of a high degree of constancy in one group, while extremely variable in another; and characters are often most constant when most adaptive.

Hornbooks.—Hornbooks—those leaflets containing the alphabet, the a-b-abs, a text for exorcism, the Lord's Prayer, and the Roman numerals, framed and covered with transparent horn as with a glass—with which the first lessons in reading were administered to our ancestors, have disappeared so entirely that they are hardly known except to antiquaries, yet they were common in England down to the time of George II, and were introduced into America in the seventeenth century. Mr. Andrew W. Tuer, who has written their history, says that the preservation of many of those which have come down to us is due to the tricks of little boys, who dropped the hateful things through cracks in the floor or wainscoting, to be brought to light again when the house was pulled down. The earliest hornbook known to be left, which is assigned to the middle of the sixteenth century, was found behind the paneling of a farmhouse. A hornbook called the Middleton was discovered in 1828 in the thatch of an old cottage. As spelling books came more and more into use, hornbooks became obsolete; and when they were no longer in demand it is said that a million and a half were destroyed in one warehouse. They could, however, be found in use in the country villages down into the present century; and there may be people still living who took their first lessons from them, and had scholastic chastisement administered with the backs of them. As they became scarce, specimens of them rose in value; and while the usual price of them had been a penny, three halfpence, or twopence, a famous copy—the Bateman Hornbook—was sold at auction for three hundred and twenty-five dollars. This book was three inches and three quarters high and two inches and seven eighths wide, with a handle an inch long, and was covered, except the handle, with leather. The alphabet was preceded by the Cross, and this was the case with most of the hornbooks. Hence the phrase, "criss-cross row." The back was stamped with a figure of Charles I, bareheaded and in armor, on horseback. At the top corner and facing the king was a large celestial crown, issuing from a cloud above his head, and in the other corner an angel's face and wings. The book bore other marks of less interest. Some of the hornbooks were costly. Queen Elizabeth gave one of silver filigree to Lord Chancellor Egerton, and others were made of ivory and bone. Finally, we come to the gingerbread hornbook, which seems once to have been a common baker's dainty. Of it Prior wrote:

> To Master John the English Maid
> A Hornbook gives of gingerbread;
> And that the Child may learn the better
> As he can name, he eats the Letter.

Hornbooks may be seen portrayed in pictures by the German and Dutch masters, as in Rembrandt's "Christ Blessing Little Children" and the works of Jan Steen and Van Ostade.

Value of "Useless" Research.—The report of the British Association's committee on the establishment of a national physical laboratory, after referring to what is done and what can be done for promoting research by the universities and schools and other existing institutions, specifies particular types of investigation which are outside the range of effort possible for such institutions or for an individual—such as observations of natural phenomena, the study of which must be protracted through periods longer than the average duration of human life; testing and verification of physical instruments and preservation of standards; and the systematic and accurate determination of physical constants and numerical data which may be useful for scientific or industrial purposes. In the discussion of this report, Prof. Fitzgerald opposed divorcing the universities from research, but hoped they would teach the usefulness of "useless" research, while investigations of commercial importance should be relegated to a national laboratory. Prof. Kohlrausch, of the Physical Training Institute (the Reichsanstalt) at Berlin, showed how completely that institution was answering the purposes for which it was founded, as illustrated in the great development of the technical glass industry, particularly of thermometer-making; the improvement of photometers and standards for measuring light; and researches in apparatus

for measuring furnace temperatures. Scientific discovery, he declared, whether costly or cheap, is, in its results, beyond price, for you never know whether the abstract discovery will not lead to inventions of great industrial importance. He could point to quite small physical discoveries which later received great technical applications. When Huygens investigated the singular double refraction of calcareous spar, no one supposed that so small a point in physics would have a commercial value over the whole world in the sugar industry and in brewing.

Agricultural Depression.—A recent editorial in Garden and Forest, under the above title, deserves the careful attention of the farmer. It is based on an address delivered by Prof. Bailey before a horticultural school in this State. Prof. Bailey protested, in the first place, against the prevalent idea that the farmer is suffering more than other members of the community. He is suffering from the general stagnation of business, and is no worse off than his neighbor. There is no special road to renewed prosperity for the farmer unless the condition of the whole country is improved, and any legislation designed to aid farmers as a class would be not only ineffective but pernicious. The farms of New York State average from three thousand to five thousand dollars in value, and with this capital invested prudent farmers are able to support their families, while it is doubtful if the same amount of capital invested in business would average as much. Prof. Bailey added that under the homestead act great areas of free and railroad lands were taken possession of by numbers of immigrants who rushed into the West to make homes for themselves. The area of cultivated land increased at a much more rapid rate than the population grew, and a surplus of breadstuffs soon caused depressed prices. Since the greater part of our arable lands are now occupied, the population is growing more rapidly than the area of cultivated land is expanding, so that we may look for the time in the near future when the demand for food will, in some measure, equal the supply, and then the stringency will cease and the farmer may expect a greater reward for his labor; and not only this, but we may expect a great advance in agricultural and horticultural science and practice in the next few years. "Phosphates from rock and potash from the Stassfurt mines are already cheap, and even now it is announced that German investigators are on the eve of perfecting processes for drawing upon the vast stores of nitrogen in the air, so as to make that most expensive element of plant food as cheap as the others. Prof. Nobbe, of Saxony, the distinguished plant physiologist, claims that he has produced on a commercial scale pure cultures of the different bacteria which are efficient in affixing the free nitrogen of the air in a form available for plant food, and has them for sale in small glass bottles. It is claimed that the soil can be inoculated with these organisms for the modest sum of one dollar and twenty-five cents an acre. Of course, it may be premature to place much confidence in this new method of securing fertility, but it has long been considered probable, and is of enough importance to have been made the subject of several papers read before the Royal Agricultural Society of England."

Exploration of Spitzbergen.—The exploring expedition of Sir Martin Conway and Mr. Trevor-Battye to Spitzbergen had among its members a geologist, a naturalist, and an artist—three factors to the production of as complete a picture as possible of what they saw. The object of the journey was to penetrate into the interior of the island, of which the coast was already fairly well known. The spectacle as they entered one of the western fiords was described by Sir Martin Conway in the British Association as having been extraordinarily brilliant. "They thought Spitzbergen must be in heaven." They had anticipated, from what had been written of the country, that they would have to cross either glaciers or a snow sheet, and had therefore provided themselves with Nansen sledges. But as they proceeded it proved that their journey was to be over broken stones and bogs. On the first day, when they had journeyed half a mile, they found that their path lay between a slope on the right and cliffs on the left, while every four or five hundred yards there was a deep gully with practically vertical sides. These gullies were filled with rotten snow. On the first day they covered about three miles, and their progress through the island was a repetition

of that experience. They had gone too early. If they had started at the end of August instead of the end of June, the snow would have been melted, and they would have made better headway. Eventually they got some distance inland, and then they turned south-east in the direction of Advent Bay. On their way they found a peak near them, which they climbed. The rock was rotten, there were large holes through it, and the whole seemed to tremble with the weight of a single man. On reaching the top they found that the white plains they had seen on landing consisted of a number of plateaus, and that valleys of much greater extent lay between. Descending, they entered a large valley which was enveloped in cloud, and for five or six hours were passing, sometimes up to their knees, sometimes up to their waists, through some exceedingly soft slush. In time they reached the foot of a very remarkable glacier which afforded some valuable observations on the nature of glacier advance. Returning from Advent Bay the way they came, they next made a journey eastward across the island. They encountered the same conditions till they came to a wall of ice, which proved to be the side of a glacier. Crossing this the next day, they reached the sea, thus completing the passage across the island. The main geographical point to be noticed in connection with their journey was that while both in the north and the south of the island there was a complete ice sheet, the central region consisted of a great bog—"a mere pudding of ice and stones."

Evolution of the Bicycle.—"At the end of the seventeenth century, in 1693," says M. Baudry de Saunier, who is quoted by M. Gaston Tissandier in *La Nature*, "Ozanam, a member of the Royal Academy of Sciences, spoke of a mechanical vehicle in the possession of a friend of his, a doctor in La Rochelle. A servant, mounted behind, made it go, resting on two pieces of wood which communicated with two wheels working the axle." In 1796, M. de Sivrae, realizing that the simplest construction was the most efficient, devised a machine of three wooden parts—a solid beam and two wheels. The beam was furnished in front and back with two forks, between the branches of which the wheels turned; to these were added a seat and a cushion. This vehicle was called the *célérifère*, or carry-fast (Latin, *celer*, fast, and *ferre*, to bear). In 1818, M. le Baron de Drais de Sauerbon, farmer and engineer, modified the célérifère by cutting the front away from the beam on which the rider was supported, and reattaching it with a pivot, which permitted it to be turned to the right or the left. Henceforth it was not necessary, as it had been before, to knock the front wheel of the machine with the hand to the right or left, whenever the rider wished to turn it, but the wheel itself became a readily acting rudder. Baron Drais rejoiced much in the contemplation of his carriage, and giving it his name, called it the *Draisienne*, or Draisian, and ordered his servant to exhibit it and display its methods of working before the sightseers in the Tivoli Garden. The servant proved awkward at the business, and only succeeded in giving himself many knocks and having the children run and shout after him. Discouraged and annoyed by the caricatures of his experiment which were published, Baron Drais went to live in a convent at Carlsruhe, where he died in 1851. The English modified his idea, and, substituting iron for wood, which had the faults of swelling and shrinking and cracking, made of the Draisian the pedestrian-horse, or hobby-horse, which was much in vogue for a considerable time. None of these machines were really ridden; they were simply contrivances to expedite walking. They were propelled by kicking, and the riders seldom let both their feet leave the ground at once, or, if they did, only for a very short time; but with their aid every step became considerably more than a pace, and the ground was got over much more rapidly.

American Women's Art.—Artistic wood carving, according to Mr. Benn Pitman, secured its first distinct recognition as woman's work in 1872, when examples of carved furniture, doors, and baseboards executed by women of the author's family were shown at an exhibition in Cincinnati. Much interest was aroused by the display, and a general desire was created in other women to do similar work. In 1873 a practical art department was established in connection with the Art Academy, to which Mr. Pitman and

his daughter gave their services gratuitously. The experiment was regarded with great interest, and more than sixty ladies, "representing the culture and intelligence of the city," began practical designing and carving. The class grew and numbered one hundred and even more for years. Ninety-five per cent of the pupils were women. Etching and hammered metal work were soon added to the studies, and china painting was taken up in 1875. In the fall of that year a considerable sum of money was raised by gift and the sale of beautiful examples of china painting, which went to the fund for the erection of the Woman's Pavilion of the Philadelphia Centennial Exhibition. More than one hundred specimens of china painting were included in the Cincinnati school exhibit at Philadelphia. No woman's product, distinctively American, has perhaps attained such repute as the Rockwood pottery of Cincinnati. "Its celebrity is due to varied causes. Excellence in material, form, firing, and glaze are points of superiority necessary to success, but that which has mainly contributed to its renown is unquestionably its realistic style of decoration," which "appeals to a newly awakened intelligence which appreciates original, careful, and truthful studies from Nature."

An Ethnological Storehouse.—An "ethnological storehouse" is urged by Prof. W. J. Flinders Petrie as necessary by reason of the impossibility of preserving more than a small portion of the material for anthropology in the very limited area of London or town museums. This leaves only two alternatives —the destruction of material which can never be replaced, illustrative of modern races now fast disappearing, and ancient races as revealed by excavation; or the storing of such materials accessible in a locality and a manner which shall yield the greatest possible storage space for a given expenditure. Such a repertory might be solely anthropological, including an example of every variety of object of human work of all ages, or it might be extended to zoölogy, mineralogy, and geology. The least to be expected from such a place would be to store the surplus objects which can not find place in existing museums. Its greatest development, however, would be to form a systematic collection of man's work, ancient and modern, reserving to existing museums such objects as illustrate the subject best to the general public, and such as need the protection due to their market value; and these could be properly represented in the repository collection by photographs. If fully developed, such a repository would become a center for study and higher scientific education. The author proposed a site of five hundred acres within easy reach of London, on which buildings could be erected as needed. The features in favor of the project and against it were discussed in the British Association, and some substitute propositions were offered; but Prof. Petrie pronounced the last mere palliatives, which did not touch the broad view.

Insect Enemies of the Grape.—An interesting article by C. L. Marlatt on the Principal Enemies of the Grape has recently appeared in the Year Book of the United States Department of Agriculture. The rapid growth of the vine industry in this country and the increasing cultivation of the less vigorous European grapes have combined to make the above subject one of considerable commercial importance. Nearly two hundred different insects have already been listed as occurring on the vine in this country; few of these, however, are very serious enemies, being either of rare occurrence or seldom numerous. The principal enemies of the grape-grower are the grape phylloxera, the grapevine fidia, both chiefly destructive to the roots; the cane borer, destructive particularly to the young shoots; the leaf hopper, the flea beetle, rose chafer with its allies, and leaf folder, together with hawk moths and cut worms, and the grape-berry moth, the principal fruit pest. The extent of the loss that frequently results from the ravages of these insects is something enormous. The phylloxera, when at its worst, had destroyed in France some 2,500,000 acres of vineyards, representing an annual loss in wine products of the value of $150,000,000, and the French Government had expended up to 1895 in phylloxera work over $4,500,000, and remitted taxes to the amount of $3,000,000 more. The leaf defoliators, as the rose chafer and flea beetle, frequently destroy or vastly injure the crops over large districts, and the little leaf hop-

per, though rarely preventing a partial crop, is so uniformly present and widely distributed as to probably levy a heavier tribute on the grape in this country than any other insect. These insects are, however, all amenable to treatment, and the loss may be very considerably limited if the proper methods of control are followed out. Mr. Marlatt gives a description of the above insects, with illustrations of the various stages of each, and finally the remedies, and methods of employing them which have been found most efficient in combating each pest.

MINOR PARAGRAPHS.

THE winter courses of Saturday evening lectures (1896–'97) at Columbia University, in co-operation with the American Museum of Natural History, began in December with a course on the Mountain Ranges of Western North America. The course for January will be upon Anthropology and Ethnology, and will include lectures on The Oldest Signs of Man in America, by Dr. D. G. Brinton; The Native Industrial Arts of the Indians of the United States, by Prof. Otis T. Mason; Art of the North American Indians, by Dr. Franz Boas; The Organization of the Family, by Livingston Ferrand; and Some Peculiar Peoples of Southern France, by Dr. William Z. Ripley. In February four lectures on Alcohol and Alcoholic Beverages will be given by Mr. C. E. Pellew. The lectures in March will consist of botanical studies—Among the Lower Fungi and The Haunts and Habits of Ferns, by Prof. Lucien M. Underwood; and Edible and Poisonous Mushrooms and Medicinal Plants, by Prof. Smith Ely Jelliffe. The lectures will be illustrated. Tickets of admission may be obtained without charge by application to the secretary of Columbia University.

M. BERTHELOT observed, in his address at the opening of the International Congress of Chemists, that the progress of mankind has heretofore been accounted for by historians as the combined effects of inner evolution of ideas and the external and empirical intervention of fortuitous events reacting upon the collective passions, feelings, and interests of men. However such views may have been justified to a certain extent by the study of the past, they fail to account for what results now from the ever-increasing influence of science, or deliberate reflection and reason as determined by the observation of facts and experimentation. In evidence of this view, M. Berthelot cites the changes that have taken place in Europe in the last half century in consequence of the increased facilities of communication, as by railroads, the telegraph, and the telephone. These changes are the rational result of facts and laws discovered in scientific laboratories.

THE liability to error in even the best-made thermometers, is well known, and the numerous cheaply made affairs with which the market is flooded are almost worthless on this account. Dr. T. L. Phipson calls attention in the Chemical News to the dangers which may result from the use of inaccurate thermometers in the sick-room, and gives the following instance as an illustration: "A patient, eighty years of age, suffering from bronchitis, did not cough or suffer from prostration when the thermometer registered from 68° to 70° F., but fell into an alarming state of prostration when it rose to 72° or 73°. Now, many thermometers, both mercurial and spirit, which I have examined of recent years have shown errors of 4° or 5° F., and sometimes even more, and it is hence very essential that all such instruments used for taking the temperature of sick-rooms should be carefully compared from time to time with a standard instrument of known accuracy."

IT is reported in Nature that letters have been received from Prof. Sollas which show that, so far as the main object of the coral-reef boring expedition is concerned, the effort has been an almost complete failure. They reached Funafuti safely, set up the apparatus, and a bore hole was carried down to a depth of about sixty-five feet, when further progress was stopped by the drills running into a material like quicksand, which choked the bore hole. Very little solid coral rock was pierced. Another boring was attempted, with the same result, at seventy-two feet. The material struck was a kind of quicksand

containing "bowlders of coral." As fast as the sand was got out fresh material poured in, and the water pumped down the tube with a view of cleaning it actually flowed out into the surrounding bed. So far as the reef was pierced, it proved to be not solid coral, but more like a vast coarse sponge of coral, with wide interstices either empty or sand filled.

Signor Luigi Palmieri, the famous Italian meteorologist, who died September 10th, was especially renowned for his observations of the volcanic phenomena of Mount Vesuvius, where he was director of the observatory for forty-two years. He was born at Faicchio, Italy, in 1807, and was Professor of Mathematics successively at Salerno, Campobasso, and Avelino, and afterward Professor of Physics at the Normal School and in the University of Naples. He was appointed to the Observatory of Mount Vesuvius, where he spent the remainder of his life, in 1854. He invented some extremely delicate instruments in the course of his researches—a bifilar electrometer, used in the study of atmospheric electricity; a pluviometer; and a seismometer for the detection and measurement of ground vibrations. With the last instrument he was able to detect extremely slight movements of the ground and to predict the eruptions of the volcano. During the eruption of 1872, while every one else fled as far from the mountain as he could, he stayed at his post and wrote a description of every phase of the phenomena.

The death was announced in September, 1896, of M. Armand Hippolyte Louis Fizeau, a French physicist, eminently distinguished for his experimental determinations of the velocity of light. He was born in 1819, the son of a distinguished physician, and, having an independent fortune, was able to devote himself mainly to science. He communicated the results of his experiments in numerous memoirs to the Academy of Sciences and to the *Annales de physique et chimie*. Many of these were very important. He received in 1856 the grand prize of one hundred thousand francs awarded by the Academy of Sciences. One of the most interesting of his discoveries was that of the means of determining by means of the alteration of the wave-lengths as revealed through the spectroscope the direction and velocity of motion of bodies advancing or receding along the line of vision, a method which has been much used by astronomers in late years with very fruitful results.

Dr. Harley pointed out, in the British Association, that an understanding of the fast-dying system in Australia of conveying ideas by horizontal straight lines might afford a clew to the better interpretation of the ancient Irish oghams, as these two systems are identical in form and to a certain extent in modes of arrangement. The Gilas of central Asia had also the same linear forms of writing, the same grouping of the characters, and a distinctly columnar arrangement. The author thought that the Australian aborigines had advanced one stage beyond the ancient Irish, inasmuch as they possessed two distinctly different kinds of line characters—small and large—analogous to our capital letters, and also adopted the plan of emphasizing the small characters by turning them into a kind of Italics. All the natives did not write alike.

In view of the anticipated exhaustion of the quarries of lithographic stone at Solenhofen, Bavaria, the use of aluminum as a substitute in engraving has been suggested, and the German journal, *Neueste Erfindungen und Erfahrungen*, enumerates the qualities that may render that metal suitable for the purpose. The Natianal Druggist, of St. Louis, points out, however, that there are lithographic quarries in Tennessee which can furnish immense quantities of stone fully equal, for purposes of engraving, to the best Solenhofen.

M. Félix Tisserand, Director of the Observatory at Paris and professor in the scientific faculty, whose death has been recently announced, was one of the most famous French astronomers and the author of important works. He was born in 1845, and obtained the degree of Doctor in Science in 1869. In 1875 he was appointed by Le Verrier Director of the Observatory at Toulouse, and was also Professor of Rational Mechanics there. He became astronomer adjunct at the Paris Observatory in 1878, Professor of Astronomy in 1883, and Director of the Observatory in 1892. In his works he treats

of the most complex and arduous astronomical questions. He was a member of the commission to observe the great solar eclipse of 1868 and the transits of Venus of 1874 and 1882. His most considerable book was the *Traité de Mécanique Céleste*, which was published in 1890, and has become an authority on the subject. His other principal books are the Lunar Tables; a treatise on the Movement of the Planets around the Sun, according to Weber's Electrodynamic Law; a work on Shooting Stars; Observations of the Sun Spots at Toulouse in 1874 and 1875; and a collection of Exercises on the Infinitesimal Calculus.

BACTERIOLOGISTS, says Sir Joseph Lister, are now universally agreed that, although various other conditions are necessary to the production of an attack of cholera than the mere presence of Koch's comma bacillus or vibrio, yet it is the essential substance of the disease; and it is by the aid of the diagnosis which its presence in any case of true cholera enables the bacteriologist to make that threatened invasions of this awful disease have of late years been so successfully repelled from English shores. "If bacteriology had done nothing more for us than this, it might well have earned our gratitude."

NOTES.

THE observation made by Mr. Alfred Springer five years ago that the acoustical properties of aluminum are approximate to those of wood, has been verified by continued experiments with sound-boards of that metal, and the author exhibited in the American Association several aluminum violins, together with a device, called a bass bar, by means of which the quality of the tone produced by the instrument can be controlled.

ACCORDING to President T. Kirk, of the Wellington (New Zealand) Philosophical Society, the chief agents, next to man, in the destruction of native species of plants in the colony, whereby the way is cleared for introduced species, are sheep, rabbits, and the black rat. These animals have almost laid several districts bare, leaving only the sturdiest and most persistent growers. Introduced plants—silenes, whiteweed, docks and sorrels, chess, and velvet grass—have nearly driven out the original littoral vegetation in some places. Even more destructive are the ravages caused by the parasites which these strangers bring with them. While the first catalogue of naturalized plants in New Zealand, published in 1855, comprised forty-four species, the present number is put by Mr. Kirk at three hundred and four, and by others at three hundred and eighty-two.

THE ruins of Tepoztlan are regarded by Mr. H. Saville as especially important because they are the only American ruins to which a definite date can be attached. The sign of Ahuizotl, the immediate predecessor of Montezuma, is engraved on one of two slabs in the walls, and on the other the date, ten Tochtli, which corresponds to 1502.

DR. H. C. HOVEY called attention in the American Association to certain old monuments in colonial graveyards, particularly at Byfield and Newbury, Mass., and also to some milestones and stones in the foundations of old houses, which were carved in a style very unlike that of Puritan monuments. The symbols on them are pagan rather than Christian, and include disks, whorls, *fleur-de-lis*, phallic signs, and a design representing the sun-gods' bride with a sunburst over it. It may be suggested as a solution of the enigma they present that the maker of them had seen figures of the kind somewhere, or pictures of them, and copied them in the desire to offer something new and striking.

IN one of his papers on the history of Niagara Falls, read in the American Association, Mr. G. K. Gilbert presented evidence of a former outlet of Lake Algonkin draining the upper lakes, heading at Kirkfield, Ontario, and following the Trent River to Lake Ontario, which belonged to an earlier date than the outlet through Lake Nipissing and the Ottawa River. There appear, therefore, to have been two periods after the origin of the Niagara River in which it was an outlet for the Erie basin only, and did not carry the waters of the upper lakes.

THE making of the Mammoth Cave is attributed by the Rev. H. C. Hovey, D. D., in a paper read before the American Association, wholly to the solvent action of water upon the limestone. No earthquake disturbance or pot-hole action in the deep parts of the cave can be considered as having had any important effect upon the excavation.

"WHAT is the bark?" is asked in a paper read before the American Association by C. R. Barnes, who calls attention to the varying use made of the term bark by different botanists. The Germans use *Borke* and *Rinde* to denote respectively the external tissue of the root or stem which dries up, and the entire mass of tissue outside the cambium. In this they are followed by the English; and the American usage, except as modified by foreign influence, assigns the name bark to the entire mass of tissue outside the cambium. In this use we are followed by the French. The author advocated

the use of the word bark in this sense, and of cortex to designate certain parts of the bark, indicated by a preceding adjective.

FORMALDEHYDE is commended by E. A. de Schweinitz as possessing many good points as a disinfectant. Anthrax, tetanus, etc., are destroyed by it. It is a good deodorizer, for which use only very small quantities are required, which may be applied by spraying. It is a good preventive of decomposition. The sharp odor it leaves, the length of time necessary to remove which constitutes the chief objection to its use, can be counteracted by spraying with ammonia.

AN experimental race was recently made in a French office between a skillful typewriter and an expert penman, the test being the number of times a phrase of eight words could be reproduced in five minutes. The typewriter scored thirty-seven and the penman twenty-three.

FROM experiments on four coal-tar colors —methyl orange, coralline yellow, saffroline, and magenta—H. A. Weber has found that no one of these affects both peptic and pancreatic digestion, but that each affects seriously one form or the other. In the discussion of this paper in the American Association it was held that too much importance was attached to such experiments, for the quantities of the substance in question used in food stuffs are extremely small.

IT has been discovered by Surgeon-Major Bruce that the tsetse fly—the terror of equatorial and South African colonists, on account of the deadly effect of its sting on cattle—is itself innocuous, and is fatal to animals only when it introduces a flagellated infusorian or hæmatozoon into the blood of its victims.

THE Botanical Society of America, at its recent annual meeting at Buffalo, elected Prof. John M. Coulter as its next president, and Charles R. Barnes, of the University of Wisconsin, secretary. President C. E. Bessey was appointed to confer with a committee of the National Educational Association regarding the unification of requirements in botany for entrance to colleges. The address of retiring President Trelease was on Botanical Opportunity.

PROF. BENJAMIN APTHORP GOULD, one of the most eminent of American and of the world's astronomers, died at his home in Cambridge, Mass., November 26th, from the effects of a fall downstairs. He was seventy-two years old. An excellent sketch of his life and the work which made him famous and increased the glory of American science was given by Erving Winslow, with a portrait, in the Popular Science Monthly for March, 1882. An account of his great work at the observatory of Cordoba, Argentine Republic, given by Prof. W. A. Rogers in 1886, showed that he had then made two catalogues of stars—one a general catalogue extending to the south pole, containing 34,000 stars, and a catalogue of zone stars, numbering 73,000; the two catalogues representing about 250,000 observations, a large part of the work on which was done by Prof. Gould personally. The whole number of stars in the two Cordoba catalogues was nearly three times as great as in any catalogue that had been till that time constructed. The results of these observations and those of the meteorological observations instituted by Prof. Gould at places in all parts of the Argentine Republic are embodied in several large quarto volumes published in sumptuous style by the Government of that country.

SIR FERDINAND VON MÜLLER, colonial botanist of Victoria, who died in Melbourne, October 9th, was born in Rostock in 1825, was educated at Kiel, and emigrated to Australia in the hope of improving his health. Having established his residence in Melbourne, he became an indefatigable botanist and explorer. He was a member of several scientific expeditions in central and western Australia, traversed much hitherto unknown country, and made important collections. He acted as an adviser to the Government in matters of exploration, and took great interest in the opening up of New Guinea to science and commerce and in antarctic research. He became director of the Melbourne Botanic Garden in 1852, and when removed from that post in 1873 to give way to a practical gardener he was appointed colonial botanist. He made elaborate studies of the Australian flora, and when he found that he was not able, on account of his remoteness from the great libraries and collections of Europe, to make the best of his material, he sent it to Mr. Bentham, to be used in the preparation of the *Flora Australiensis*. His researches lay in the direction of descriptive and applied rather than morphological botany. He was a fellow of the Royal Society, and received one of its royal medals in 1863. He was a knight of the C. M. G., was made a baron by the King of Würtemberg, and received decorations of some kind from nearly every civilized government—of which he was proud.

IN a paper on the sailing flight of birds, read in the British Association, Mr. G. H. Ryan pointed out that the support of a bird indefinitely in the air without flapping its wings is apparently contrary to the law of the conservation of energy, and must be due to either upward air currents, variation of wind velocity with altitude, variation of wind velocity with time, or the presence of vortices in the air. In the discussion of these theories, each of which was considered, the author expressed the opinion that birds in flight are often carried up by a side gust of wind, and that this is one of the causes of the phenomena presented by the sailing bird.